Fermilab

Final Report

Directors' Review
of
the DES Project

August 21-22, 2008

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Executive Summary

Technical

There has been significant technical progress on DECam since the December Directors' Review and the January DOE / NSF Review. The optics lens blanks have been completed and sent to the polishing vendor who was selected in April. The hexapod design / fab vendor has been selected, a design completed, and an engineering study including a "first element" fabrication and test is underway. Progress on CCD fabrication, preparations for tests, and actual tests is good.

The Data Challenge 3 (DC-3) on the DESDM effort was conducted largely successfully and major preparations for DC-4 are being made.

A rather complete current plan for the CFIP effort was presented. It might be useful to put this into a summary level schedule (using some tool like Microsoft Project).

The DES Calibrations Scientist who resides in the DES Project Office has begun looking seriously at calibration

Schedule

All aspects of DES appear to be on or close to on schedule. DECam is falling slightly behind the baseline schedule on WBS 1.5 Opto-Mechanics

The DES Project Office had hoped to be further along in addressing recommendations from prior reviews, but completing the formal execution of the MOU took significantly more time than had been anticipated. They are in the process of addressing these recommendations.

It is planned to have the DECam hardware delivered, assembled, and tested at the Blanco in March 2011 ready for installation and commissioning. The formal CD-4 milestone is one year later.

Cost

Cost performance is good.

Funding

DECam funding is now proceeding well. During the "tough" early FY2008 period the DECam project and DES at large benefited greatly from significant contributions by Collaborating Institutions and sponsors including:

1. Portsmouth, Penn, Chicago, and Ohio State provided the funding that enabled UCL to purchase the glass blanks from Corning.

2. STFC awarded UCL 1.1 million pounds in April enabling UCL to place the order for the polishing contract.

3. The NSF awarded FRA, Penn and UIUC $2.8 M effective August 15 for the continuation DESDM Project and collaboration support.

4. The DOE request for the Office of High Energy Physics in the FY2009 Congressional Budget Request included $8.9 M for the DECam Project. (Although this is FY09 funding, it allows solid planning now.)

Regarding an anticipated extended Continuing Resolution in FY09, for DECam there have been discussions with Fermilab management and OHEP and the intention is to keep the project on track.

Management

In the management arena DECam is doing well. They're tracking staff and progress closely. They've identified engineering short falls early and worked proactively first with Fermilab then with collaboration members from other institutions to meet critical needs as well as possible. This has proven less than ideal, but is meeting the basic needs.

The committee feels that DECam is ready for CD-3b approval.

DESDM in agreement with / response to prior Review Committees has increased staff by 1.8 FTEs on a 4.2 FTE base. They intend to submit a supplemental request / proposal to NSF early next year.

New directors have been named at NOAO and at CTIO.

A formal DES Memorandum of Understanding has been executed and a copy was provided to DOE and NSF in May. The DES Project Office staff has been augmented by one senior person who will develop an Integrated Project Schedule and "manage" shipping. Another senior person is actively addressing Calibration. And yet another person is being sought to focus on and coordinate overall Systems Integration along with a Systems Integration Working Group that is being formed by the DES Director.

The Fermilab Director greeted this Directors' Review Committee noting that DES is a key element of the Fermilab program addressing the Cosmic Frontier. The newly appointed Head of the Fermilab Center for Particle Astrophysics also addressed the Committee and enthusiastically stated his support for the Dark Energy Survey.

1.0 Introduction

A Directors' Review of the DES Project was held on August 21-22, 2008. The charge included a list of topics to be addressed as part of the review. The assessment of the Review Committee is documented in the body of this report.

Each section in the report is generally organized by Findings, Comments and Recommendations. Findings are statements of fact that summarize noteworthy information presented during the review. The Comments are judgment statements about the facts presented during the review and are based on reviewers' experience and expertise. The comments are to be evaluated by the project team and actions taken as deemed appropriate. Recommendations are statements of actions that should be addressed by the project team. A response to recommendation(s) is expected and the status of actions taken will be reported on during the DOE/NSF Review of DES scheduled for September 9-10, 2008. Additionally, Progress on the recommendations is to be reported on during future Project Management Meetings (PMGs) and during future reviews.

Reference materials for this review are contained in the Appendices. The Charge for this review is shown in Appendix A. The review was conducted per the agenda shown in Appendix B. The Reviewer's assignments are noted in Appendix C and their contact information is listed in Appendix D. The Review Participants are listed in Appendix E. Appendix F is a table that contains all the recommendations included in the body of this report.

2.0 DECam

2.1 CCDs

Findings

- The project has successfully developed packaging hardware and handling techniques for large area CCDs and are very close to final packaging parts. A packaging procedure has been developed which solves bonding-related problems and minimizes CCD handling. They have been proactive in managing CCD production. The processing rate at Dalsa and LBL does not appear to be a concern. However production yield of CCDs remains a significant risk which is outside of the direct control of the project.

- Ten wafers, belonging to lot 2C and 2D, were found to have very low yield. The collaboration has good confidence that this was ESD damage, in which the thinning vendor SiQuest did not take all the required precautions. The collaboration is likely to rely on Umicore for the bulk of the remaining thinning work.

Comments

- We commend the collaboration for continuing to work with the silicon processing vendors to understand the processing defects.

Recommendations

1. The collaboration should make sure that ESD precautions have been communicated to all silicon processing vendors. The collaboration should explore implementing a change-control protocol with the vendors. For example, the processing vendors should document all the processing changes to personnel, equipment repairs, upgrades, or maintenance. If possible, the vendors should notify the collaboration of changes before they take place.

2. The collaboration should make sure that exhaustive analysis of power-failure scenarios that could damage the CCDs is made. This is on a par with what HEP collaborations have done with their silicon devices.

3. CCD/Integration - A person should be identified with the responsibility for coordination of the integration and testing of CCDs, hardware, and SISPI software in Lab A and beyond.

2.2 Front End Electronics

Findings

- There are prototypes for most of the modules, many of which are based on the existing Monsoon system. Final versions of the vacuum interface board, kapton cables and clock boards should be available before the end of CY2008. Delivery of the water cooled crates should also occur within the next three months. The schedule appears to be consistent with integration plans at Lab A.

Comments

- Meeting the total noise spec of <15 e/pixel is challenging. Careful understanding of grounding and shielding is particularly important. The visit of FNAL engineers to CTIO was a good step in this direction. Use the lab A test to aggressively test the electronics system. Performance in the following areas should be quantified:
    - Noise
    - Stability
    - Error rates
    - Mechanical Quality
    - Interconnection reliability
    - Cross talk

Recommendations

- None

2.3 Survey Image System Process Integration (SISPI)

Findings

- The SISPI team consists primarily of "in-kind" scientist contributions, with many organizations contributing parts of the control and data transmission software. The software will be based on python wrappers and will communicate with the labview-based telescope control system.

- There appear to be no milestones in schedule related to upcoming integration testing in Lab A.

Comments

- As a subproject that is primarily in-kind there continue to be concerns about manpower and organization. The project includes a number of different control and interface systems which must work together smoothly and reliably for non-expert users.

- SISPI - The requirement that the SISPI code be maintainable by the CTIO staff should include a definition of what skills, documentation and knowledge is needed for on-site maintenance of the code and what "maintenance" means. This should be agreed with the responsible CTIO staff members.

- An experienced observational astronomer should be part of the SISPI team.

Recommendations

4. The project should define explicit goals for integration and testing of software components working with either existing hardware or hardware emulators. Integration of the SISPI system in the Lab A tests, including specific goals, should be aggressively pursued.

2.4 Opto-Mechanics

Findings

- Hexapod design and engineering is a long-lead item included in the CD-3a approval. ADS International is the contractor for a two-step contract for design and fabrication of the hexapod. Step 1, the engineering study is underway, and will conclude with full tests of one actuator this fall. Completion date for step 1 is December 1st. Step 2, hexapod fabrication, will follow.

- Hexapod vendor oversight includes bi-weekly teleconference meetings. A design review was held at the ADS facility at the end of July.

- Tests of the LN2 system have begun in Lab A.

- Vibration studies, including a finite elements analysis of the telescope structure with DECam and vibration measurements on the telescope at Cerro Tololo have been done. Analysis is still in progress.

- Engineering staff effort has been augmented by obtaining engineering help from ANL on the f8 (existing secondary mirror) handling fixtures and procedures.

- The definition of "preliminary design" was discussed and clarified.

- Non-catastrophic optics breakage is not listed as a risk.

Comments

- Close vendor oversight is critical for the hexapod design and schedule. The hexapod vendor, located in Italy (ADS) has extensive experience. DECam staff are communicating often with the vendor.

- DECam engineers have a "Lab A LN2 Test Plan" which includes operating procedures, system heat load verification, vibration measurements at the heat exchanger, studies of a range of flow conditions around the design condition, and a test schedule.

- Until analysis of the vibration measurements at CTIO are complete, one cannot form conclusions about constraints on amplitudes and frequencies of possible vibration sources (such as LN2 flow). Preliminary results regarding the robust nature of the telescope structure relative to the predicted small vibrations of the cooling system indicate that the LN2 flow will not be a problem.

- Sending engineering work to ANL and UMichigan followed unsuccessful attempts to obtain more engineering help here at Fermilab, due to engineers already being fully committed to projects.

- To some people, "preliminary" would mean conceptual or otherwise very early and incomplete. In the DECam presentations, a "preliminary" design is a

complete design including engineering analysis, FEA (if required), and drawings, as far as one can go in the R&D stage. A preliminary design could be the final design, but in some cases will still be verified by means of prototype construction and tests and modified if necessary.

- There is a moderate (not low) probability of chipping off a flake at the edge of a lens during grinding. It sounds like there is plenty of optical clearance to handle even large chips and this likely will not be a problem, but if you're keeping a risk table, you might want to include this possibility (separately from the catastrophic problem) since it could be embarrassing if it happens and wasn't in the risk table. At the least, there will be a week or two in schedule as you decide on what to do about it and do it.

Recommendations

5. Due to the importance of vendor oversight for the hexapod, continue to work closely with ADS.

6. Refine the description of a design as "preliminary" either with specifics or with a definition such as the one commented above.

7. Following completion of analysis of the Cerro Tololo vibration data and measurements of vibrations in the cooling system at Lab A, review again implications, if any, for the cooling system.

8. Add small edge chips on a lens as a risk.

2.5 Management, Including Cost & Schedule

Findings

- The total cost of the project has increased since the CD-2/3a DOE/NSF Review to satisfy recommendations to add travel, engineering, and additional contingency to the scope and cost. The UIUC contributions (funded from DOE) are also now included in the project costs and reporting. The current obligation profile is shown below:

Updated Obligations Aug.08	FY06	FY07	FY08	FY09	FY10	FY11	Total
BCWS R&D + R&D Cont.	2.28	3.92	4.54	0.96	0.00	0.00	11.70
BCWS MIE (no MIE Cont.)	0	0.00	1.16	7.48	6.12	1.87	16.63
Total OBLIG (no MIE cont.)	2.28	3.92	5.70	8.44	6.12	1.87	28.33
Funding	2.28	4.76	5.60	8.90	8.61	5.00	35.15

- The project is currently 37% costed on the BAC = $28.08M with 41% contingency on the remaining scope.

- The impact of a likely FY09 Continuing Resolution has been mitigated by assurances from the Directorate that adequate funding will be made available to meet the DECam schedule requirements.

- Change control is being exercised with seven change requests approved and implemented, and three in process. This has used $273k of contingency funds and adjusted several milestones.

- The project schedule is statused each month by the L2 managers and costs are extracted from Cobra to provide earned value analysis and reporting. The cumulative SPI and CPI are within acceptable ranges.

- The in-kind contributions are monitored through many milestones at L4.

- All recommendations from the December 2007 and January 2008 reviews have been addressed.

- Implementation of the systems engineering controls and documentation is in process, with DocDB signoffs intended to be used to control changes to Requirements and Specifications Documents. This control is not in place for the Dark Energy Camera Specifications and Technical Requirements document.

- Adequate engineering resources continue to be problematic, and monitoring this issue requires significant management time.

- Several design reviews and integration meetings have occurred since the last Director's Review, the outcomes of which review are documented in Monthly Reports. These reviews addressed risk and integration management as well as technical issues. In addition, the project has instituted three issues management lists (ongoing, technical, integration) that are reviewed at the biweekly

management meeting for action. This sometimes results in additional meetings to address specific issues.

- The Preliminary Hazard Analysis Document has been signed (November 2007). Subsequently the DECam Preliminary Safety Assessment Document was written and signed (February 2008). A draft Safety Assessment Document has been prepared.

- The DECam Quality Management Plan was last updated August 2007.

- The DECam Risk Registry has been updated since December 2007 retiring the risk for production and transport of optical blanks. Risk Accounting Forms were last updated in December 2007.

- The Risk Registry and Risk Accounting Forms do not identify the Risk Owner. The "Identified by" party is listed in the Risk Accounting Form.

- The Project Execution Plan (PEP) for the DECam Project for the DES Experiment was signed in March and April of 2008. A change request has been submitted that changes some L2 Milestone names and dates listed in the PEP.

- The PEP states that variance analyses are covered in DECam Monthly Reports.

- The Start-Up Test plan is drafted as "The Dark Energy Camera DECam Telescope Installation Readiness Certification" (Docdb 1294).

Comments

- The project team is working together well to execute, manage, and monitor the project.

- Use of a change log spreadsheet to track project changes would provide a summary picture of contingency use. This could also allow status tracking of each change request with updating on a periodic basis.

- Consider identifying a single person responsible for integration on the DECam project.

- Consider providing a time-phased resource graph for the DOE/NSF review that would show the need for specific types (e.g., EE, ME) of engineering resources with an indication of assumed availability for comparison.

- Call out design reviews and integration meetings and their outcomes clearly in Monthly Reports.

- Safety and Quality Assurance documentation has been appropriately updated.

- Presentations showed that some risks have been mitigated in the R&D phase. Risk Accounting Forms (RAF) should be updated with the update date listed along with the mitigations that have occurred and future mitigations. The risk that was retired should be documented in the RAF also.

- Clearly identify risk owners, the people responsible for the risk and mitigations.

- Determine if change requests that change information in the PEP require the PEP to be updated, through discussions with the Federal Project Director.

- Monthly Reports address variance analysis well for a project of this size and scope.

- The Start-Up Test plan "The Dark Energy Camera DECam Telescope Installation Readiness Certification" is sufficiently mature for this stage of the project.

Recommendations

9. Utilize a change log and consider sign off approvals for critical design documents which should have been under configuration control since the baseline, such as the Dark Energy Camera Specifications and Technical Requirements.

10. Update Risk Accounting Forms by the DOE/NSF CD-3b Review to address progress made in R&D, new mitigation options, and any new risks discovered in bi-weekly meetings covering risks/issues and include the date of this update.

11. Update the Risk Accounting Form and Risk Registry by the DOE/NSF CD-3b Review such that they specify the risk owner.

3.0 DESDM: Data Processing & Data Management

3.1 Technical Progress/Plans

Findings

- The DES Data Management Project has two major deliverables: a data processing and archive system that can support DES Science, and a Community Pipeline for processing non-DES observations.

- The DESDM project is employing a cyclical development strategy anchored by a series of yearly "data challenges" that exercise implementations of the data pipeline and archive.

- As part of the data challenges, the Pipeline Framework has been used to process both simulated data (constructed in the form expected from the DECam) and real data from the Blanco Cosmology Survey on NCSA compute clusters.

- Simulations have made good progress since the last review, with improved artifact, defect, PSF, and galaxy models.

- Significant progress has been made in the last year on archive infrastructure based on prior data challenges and scientist input. The design includes a model for tiered archive nodes with a Data Access Framework that enables the sharing of data as well as delivery of data to the processing pipelines.

- The processing framework appears capable of the handling of the night-to-night data flow adequately, and the monitoring system appears to be well underway.

- Planning for the Community Pipeline is currently in progress. An implementation plan will be developed over the next year in coordination with NOAO.

Comments

- We find over all that good technical progress has been made to date. The data challenge appear to be well-planned and executed, and the paradigm appears to be quite effective in driving steady progress. DC-3 was a success and progress toward DC-4 is clear. The data processing system appears to be able to meet its basic goal of processing one night's of data in one night real time on the parallel system at UIUC.

- The presentations were unclear as to what degree the goals of the data challenges were met.

- The fact that there is not a strong requirement for how fast the processing must be done has allowed the team to assemble a flexible pipeline framework using existing tools (e.g. Condor, Globus, OgreScript, sextractor, swarp, etc.) that scales well.

- The DES project is attempting a very difficult (but important) piece of science, namely constraining Lambda and its derivative (or the equivalent equation of state parameters: w, w'). The methods used, in particular photometric redshifts, BAO, and SN Ia, require excellent photometry (<2% accuracy). The weak lensing technique additionally requires extremely careful modeling of the Point Spread Function (PSF), which will be variable in time and space in order to remove the PSF signature from the background shear in galaxy shapes. There will also be competition from other projects in the near term (PANSTARRS, BOSS/SDSS-III) and in the longer term (LSST), which will be measuring similar parameters at similar levels of accuracy as part of their science goals; thus, DES cannot afford to relax its already tight requirements on characterizing the PSF. Meeting the algorithmic goals is a risk, particularly given the part-time involvement of Emmanuel Bertrain.

- Compared to the other major deliverable, the Community Pipeline is under-developed. This may reflect an appropriate choice of priorities; however, there may be significant technical and management issues lurking there that could have significant impact on costs and resources.

- The team does not have a good understanding of the computing power necessary to support science queries to the database.

Recommendations

12. Presentations of a Data Challenge would benefit from a summarizing table of the goals of the challenge and the extent that those goals were met. We recognize that not meeting goals does not necessarily imply failure; thus, where appropriate a summary of lessons learned would be helpful in evaluating progress.

13. Given the challenges of funding (particularly with securing contingency), priorities should be assigned to detailed work and deliverables.

14. Because of the critical importance of measuring and modeling the PSF well, this should be given high priority in the next two challenges. PSF fitting has only recently begun to be addressed by the DESDM Science Team and it needs to be thoroughly tested with simulations as well as on real (BCS) data well in advance of first light. There should be close communication between the Sextractor developer and the simulator and science testers.

15. In general, the team should consider for the last two data challenges concentrating more on meeting science requirements rather than processing throughput, as the latter appears to be fairly well in hand.

16. The team should study the performance requirements for supporting science database queries. This analysis should be done separately for internal science goals and those of the external community.

3.2 Management, Including Cost and Schedule

Findings

- The DM project office is reasonably staffed and is utilizing standard project management practices. Project documents (PEP, etc.) appear to be current and in order.

Comments

- Development work is organized around annual data challenges, but the goals and objectives for specific data challenges were not made obvious to the review committee. Neither was the project's past performance in meeting the goals and objectives of particular data challenges. It is noted that the PEP contains a table of Level 1 milestones related to data challenges and refers to an appendix containing further details. It is also noted that the committee was told that data challenge reports contain summaries of goals met. However, in future presentations, it would be helpful for the project team to present a review of the project schedule for key deliverables, and a summary of past performance, to give an indication of the project's schedule performance against plan.

- The DM PEP contains the following guidance on determining contingency levels for DES labor: 15% for low-level risks, 25% for medium-level risks; and 40% for high-level risks. Section 6.2 of the PEP states that contingency as a percent of Total Budgeted Cost is 19.8%. If the contingency guidance was followed, this suggests that the project believes there is a low-to-medium risk in the accuracy of the cost estimates for software development. Given the inherent uncertainties in scientific software development, this seems unrealistically low. The project should review the bases of cost estimates for the various software development efforts and revise contingency levels as necessary.

- There are some questions concerning the manner and consistency in which contingency is included in the DM project budget. During the breakout session, the committee was informed that there was no cost contingency in the DM "funded" budget presented in the slides. If true, there is inadequate contingency in the current plan. However, the same budget table appears as Table 7 in the DESDM PEP. The accompanying text notes that contingency as a percent of the Total Budget Cost is 19.8%. The manner in which contingency is determined and included needs to be consistently described.

- The committee was not shown a project schedule with target completion dates for key DESDM deliverables. However, section 6.3 of the PEP contains a table of target completion dates for Level 1 milestones and notes that the project will use scope contingency rather than schedule contingency to manage development risks. Intermediate data challenges will be initiated and/or more scope will be added to subsequent data challenges to accommodate unmet goals from a particular data challenge. There is no mention of re-prioritizing deliverables or de-scoping the project, which may be necessary if too much work begins to stack up. Without understanding the relative priority of key deliverables or plans for

de-scoping the DESDM effort, it is not possible to assess whether there is adequate scope contingency or whether de-scoping will compromise key project goals.

- The level of effort on DESDM development activities has been increased in response to recommendations from previous reviews. However, it is not clear that the increase is sufficient to meet project specifications according to the current timeline. During the breakout discussion it was learned that the level of effort presented to the committee is not the level necessary to complete the project. Rather, it is the level of effort that can be supported with the current level of available funds. The project should produce a project plan that shows the amount of effort required to complete the project as planned. From this, a realistic Total Project Cost estimate, with appropriate contingency levels, can be developed. Additional tables can be created to show staffing levels and the scope of work that can be completed based on the current level of available funding.

- The development of the Community Needs pipeline requirements document continues to be delayed due to lack of resource availability. This seems to be an ongoing problem from last December.

- The DESDM project team has responded reasonably well to recommendations from past reviews. Progress has been made of 5 of the 6 recommendations from the January 2008 Joint DOE/NSF review. The response notes that some recommendations will not be acted upon until fall 2008.

- The CFIP Project Execution Plan (PEP) is still in "draft" status (draft version 5.4). The PEP should be reviewed and revised as necessary in order to move the document from "draft" to "approved" status.

Recommendations

17. Complete the necessary revisions to move the CFIP Project Execution Plan from "draft version 5.4" to "approved."

18. Fix a minor typo in Table 4 of the DESDM PEP, which contains the management reserve estimation guidelines. Under "DES Labor", the high level risk category is mislabeled as "low."

19. Improve the clarity of progress, cost and schedule reporting, to a level commensurate with that of the DECam project.

20. Revise the DM budget projection to 1) accurately reflect the estimated Total Project Cost; 2) include appropriate contingency levels; and 3) accurately identify the budget for the currently-funded level of work.

21. Table 7 (DM Project Baseline Costs by WBS) in the DM PEP needs to be revised to clarify the data shown. Columns currently identified as "contingency" should

be relabeled to indicate that these are actually estimated costs for unfunded work. In addition, a column showing true contingency should be added to the table.

4.0 Facilities Improvement Project (CFIP)

4.1 General

Findings

- PowerPoint presentations were significantly different in scope and style from the DECam presentations.

Comments

- This was also true of other non-FNAL presentations. Because FNAL presentations are the largest fraction, the contrast is noticeable. We understand that the size and scope of the CFIP work is vastly different from, say, DECam, but having closer presentation styles in status reports will avoid negative perceptions.

- The TCS and radial support slides were much more informative and detailed than some of the other topics.

Recommendations

22. Be specific in PowerPoint bullets. For example, instead of simply listing the documents needed, make a table of the document names, their due dates, and current status.

23. Similarly, writing only “Subsystem functional testing” conveys little information. Creating an MS Project schedule that shows where this (and other tasks) fits into the overall CFIP program with links (coordinated milestones) to the DECam delivery will make it easier for reviewers to digest.

24. Unload details of status into the Gantt chart (e.g., “RA encoder is installed” and “DEC encoder will be installed”) and present only significant off-schedule/budget or technically interesting items in the presentation.

4.2 Installation

Findings

- The DECam telescope installation plan is in concept stage. Tight coordination between the DECam builders and CTIO is not apparent in the slides.

- DECam will mockup the installation environment in considerable detail at FNAL.

Comments

- Understanding the installation plan details is necessary before releasing major construction work on DECam. Are pickup points agreed upon, hose and connector interfaces defined, etc.? This may have been done already, but it's not clear from the documents or presentations.

- DECam presentations indicate that they have considered connector placement, variable gravity vector problems, etc., and they plan to build a mockup of the 4m top end for fit-checks and gravity testing. It is not clear from the presentations that this is done in conjunction with the telescope installation staff. Interferences, difficult access, etc., need to be shown not to be problems with input from both institutions.

Recommendations

25. Move quickly to add an inter-institutional task that defines and approves the telescope interfaces and routine installation procedures. Preliminary line runs and a full installation walk-through example are essential to convince reviewers that the instrument change can go smoothly.

26. Visits by CTIO technical staff to FNAL would be useful in developing the installation and maintenance procedures. The site staff knows what they're comfortable and capable of doing and can provide ideas for some operations. Engaging them early also helps in the actual delivery and installation work since the work requirements will be familiar.

Findings

- The level of post-delivery DECam support provided by the instrument builders (including software) is estimated but the specific responsibilities are not sharply defined.

- The support cost seems estimated on reasonable maintenance level requirements for DECam

Comments

- It is helpful at this stage to draft specific support procedures for routine maintenance, minor repairs, major repairs, catastrophic repairs, and upgrades. Simply stating who (which institution) is responsible when certain things happen provides the overall sense of support responsibilities even if these might not happen in practice. When is it appropriate or required for CTIO staff to contact

DECam management for things like board swaps, parameter adjustments, etc. What time response is expected for repairs requiring travel to Chile?

Recommendations

27. Draft and agree upon an interface document describing typical repair scenarios and expected levels of support from all institutions. Agree upon reporting requirements for minor changes and repairs (one suspects FNAL has infrastructure for this already).

5.0 Overall Project Management Including IPS and Configuration Management

Findings

- The Project Director has worked hard to obtain a signed MOU between AURA, FRA, and UIUC.

- An Integrated Project Schedule (IPS) is being prepared to coordinate the activities of the three DES subprojects. The schedule is anticipated to be at a high level, "one page."

- Integration on the DES Project will be managed through a Systems Interface Working Group. Issues will be identified by the WG and assigned to one of the three subproject managers for resolution.

- Systems level engineering management is not clearly identified.

Comments

- Concerns regarding an overall integrated project schedule and systems engineering are being addressed by the Project Director.

- A "Systems Interface Working Group" will be formulated to discuss and address high level integration issues. Although the creation of this Working Group is a good idea, there should still be a single individual responsible for overall system integration. In addition, there is a concern that reviewing one inter-project interface per month may not be sufficient to identify and address issues in a timely manner.

- A configuration management plan exists for DECam and is being implemented, but the degree of CM formality for DESDM and CFIP is less clear. In addition, the configuration management process for the overall DES project is unclear. For example, it is not clear how a DECam change is reviewed and integrated across the DESDM and CFIP projects. The DESDM should work to implement the CM plan defined in their PEP. In addition, a CM plan should be considered for the overall DES project.

- Integration and test is a multi-institutional operation that requires deep communication and agreements on interfaces and schedule to execute.

- Difficulties in Chile that require new engineering or machining can reduce staff efficiency (either in idle time in Chile or extra travel time for a second trip). These can be all but eliminated with careful planning and interface management.

- The time to handle interface conflicts is before construction because it can be expensive (cost and schedule) to fix simple problems after construction.

- Offloading engineering & construction work to additional institutions (e.g., f/8 handler at ANL) increases interdependencies, making interface control even more important.

- A high level working group is less important than the one person who is responsible. This person should take advice from the working group, who will have broad knowledge of interface, funding, and schedule issues but should spend lots of time with Level 2 to make sure nobody is surprised at the telescope.

- The Integrated Project Schedule should incorporate key milestones from the subprojects in order to appropriately identify schedule issues among them.

Recommendations

28. A person responsible for interface control between DECam, SISPI, and the 4-m telescope (and other interface issues) should be installed. This person will handle milestone coordination and reporting between institutions; keep project activities in sync; control interface documents; and identify potential problems.

29. Incorporate subproject milestones into the IPS, with periodic statusing.

30. Regular face-to-face meetings between key project personnel to discuss interface issues and common milestones should be held, including regular meetings on-site at CTIO.

6.0 Charge Questions

Technical

6.1 Is the final design sufficiently mature so that the project can initiate procurement and fabrication?

Yes.

6.2 For those elements that are not finalized, has the project convincingly shown that there are no major issues that need to be addressed and that they have a clear path forwards toward final design?

Yes. DECam will have carried design work of all major components to "preliminary design" by February, 2009. Preliminary design, as defined by the DECam project, is a complete design including engineering analysis, FEA (if required), and drawings, as far as one can go in the R&D stage. A preliminary design could be the final design, but in some cases will still be verified by means of prototype construction and tests and modified if necessary. There appears to be little technical risk on their remaining design, and the final designs should be within the baseline.

Baseline Cost and Schedule

6.3 Are the current project cost and schedule projections consistent with the approved baseline?

DECam

Yes. The cost and schedule projections are consistent with the approved baseline.

DM & CFIP

For DM, the committee was not presented with a comparison of the current cost and schedule projections to the approved baseline, so we cannot answer this question. Moreover, the cost projection as presented is confusing. Within the cost table, columns labeled as “contingency” are in fact columns showing the estimated cost for unfunded work. Also, the project cost as shown is not Total Project Cost, but the estimated project cost from July 1, 2007 forward. The cost projection needs to be cleaned up to show Funded Project Cost and Total Project Cost, with contingencies, and a comparison to the approved baseline.

For CFIP, current schedule projections are consistent with the approved baseline. The committee was not presented with CFIP cost projections; therefore, we cannot compare the current cost projection against the baseline.

6.4 Are the allocations of contingency adequate for the risks?

DECam

Yes. There is 41% cost contingency on the remaining scope, and schedule contingency on CD-4 milestone is > one year.

DM & CFIP

For DM, there was no cost contingency in the funded budget presented to the committee; therefore, there is inadequate contingency in the current plan. In addition, the committee was not shown a project schedule with target completion dates for key DESDM deliverables. However, section 6.3 of the PEP contains a table of target completion dates for Level 1 milestones and notes that the project will use scope contingency rather than schedule contingency to manage development risks. Without understanding the relative priority of key deliverables or plans for de-scoping the DESDM effort, it is difficult to determine if there is sufficient scope contingency to preclude compromising key project goals.

For CFIP, schedule contingency is 9 months, which seems adequate given the scope of the remaining work. The adequacy of cost contingency is not known, since the CFIP budget and level of contingency were not presented during the review. A review of the CFIP PEP found that cost contingency is held by the CTIO Director, but the PEP does not provide guidance on contingency levels.

Management

6.5 Is the management structure adequate to deliver the proposed final design within specifications, budget and schedule?

DECam

Yes. The structure of the project team is sufficient to deliver the project within the baseline.

DM & CFIP

The DM management structure appears adequate to deliver the proposed final design within specification, budget and schedule. However, some additional training of the project management staff may be necessary to improve the accuracy and clarity of project plans, budgets and schedules.

The CFIP management structure appears adequate to deliver the planned facility improvements per approved plans.

6.6 Has the project responded satisfactorily to the recommendations from the previous review?

DECam

Yes. The project responded to the December 2007 and January 2008 review recommendations satisfactorily. Some actions are still in the process of being completed.

DM & CFIP

The DM project has responded satisfactorily to recommendations from previous reviews. Responses by the CFIP team were not readily available in the materials provided to the committee.

Fabrication

6.7 Has there been adequate progress on the fabrication activities approved under CD-3a?

Opto-Mechanical

Yes. The hexapod procurement, the major CD-3a approval, is proceeding with a clear plan for performance and acceptance.

Other

Good progress has been made on the procurement of CCDs and packaging components including ALN cards. LBNL is on track to complete the processing of 36-41 wafers in FY08, with equal expectations for FY09. Production versions of tooling and packaging components for 100 CCDs have been ordered.

6.8 Is the project satisfactorily prepared to execute the remaining fabrication activities?

Opto-Mechanical

For the most part, designs are mature and difficulties understood. There are some items, for example, vibration in the cooling system, that have not been characterized but are not worrisome. Other items, such as the final designs of the vacuum vessel, are not complete but pose essentially no risk given that prototyping has been done (in this case, MCCDTV).

Overall, FNAL direct responsibilities for DECam are in excellent shape both in schedule and budget. With the requested resources, there is little risk in significant delays or budget problems.

Other

The remaining fabrication activities, covering items relating to analog and digital electronics, are on track to reach the stage of being executed. Nearly all devices are available as close-to-final prototypes, and their performance will be known soon with the systems test at Fermilab (Lab A). Earlier-version prototypes have been fabricated and studied, and the performance is near to or exceeds the specs.

Documentation

6.9 Is the DECam documentation required by DOE Order 413.3A for CD-3b complete?

Yes. Design status/completeness needs to be more clearly stated in talks and documentation.

6.10 Have the CD-2 documents been updated to reflect any changes resulting from the final design?

Yes. Design documents are being updated as designs mature. No design changes have occurred that affect overall project management documents.

Appendixes

Charge

Agenda

Report Outline and Reviewer Writing Assignments

Reviewers' Contact Information

Participant List

Table of Recommendations

Appendix A

Charge

Directors' Review of the Dark Energy Survey Project
August 21-22, 2008

This Charge is for a Directors' Review of the Dark Energy Survey (DES) project that will be held at Fermilab on August 21-22, 2008. The two primary objectives of DES are the successful deployment of DECam, a world-class astronomical instrument on the Blanco Telescope, for the benefit of the entire astronomical community served by NOAO; and the successful completion of the scientific program of the Dark Energy Survey. The review will cover the three parts of the DES project: the Dark Energy Camera (DECam), the DES Data Management (DESDM), and the Cerro Tololo Inter-American Observatory (CTIO) Facilities Improvement Project (CFIP). The Directors, Peter Garbincius, Associate Director for Research for Project Oversight at Fermilab; Richard Crutcher, National Center for Supercomputer Applications (NCSA) at the University of Illinois at Urbana-Champaign (UIUC); and Dave Silva, National Optical Astronomical Observatory (NOAO), are commissioning this review.

The review will assess the readiness of the DECam portion of the project for a Department of Energy (DOE) Critical Decision 3b (CD-3b) approval. In particular the committee will assess if the project final designs are prepared to the degree appropriate to prepare procurement packages to meet the construction schedule.

The review will assess technical progress and plans for the DESDM portion of the project as documented in the DESDM Technical Design Report, the Technical Requirements and Specifications, and the Project Execution Plan. For your information, a new proposal for DESDM to be submitted to the National Science Foundation in the spring of 2009 after Data Challenge 4 has been completed and the DES Council has reviewed it and the new proposal carefully.

The review will assess the plan of the CTIO Facilities Improvement Project, which is described in the CFIP Project Execution Plan. The committee will also be presented with an overview of the process from DECam arrival to operations, and the integration of DESDM with the NOAO end-to-end (E2E) data management system.

In carrying out this charge, the review committee is requested to evaluate the progress and status of all three DES projects as well as the coordination between them.

For the DECam project, the committee should evaluate whether the final design of DECam is complete and if it's prepared to enter the next stage. In carrying out this charge, the committee should address the following specific items:

Technical

1. Is the final design sufficiently mature so that the project can initiate procurement and fabrication?
2. For those elements that are not finalized, has the project convincingly shown that there are no major issues that need to be addressed and that they have a clear path forwards toward final design?

Baseline Cost and Schedule

3. Are the current project cost and schedule projections consistent with the approved baseline?
4. Are the allocations of contingency adequate for the risks?

Management

5. Is the management structure adequate to deliver the proposed final design within specifications, budget and schedule?
6. Has the project responded satisfactorily to the recommendations from the previous review?

Fabrication

7. Has there been adequate progress on the fabrication activities approved under CD-3a?
8. Is the project satisfactorily prepared to execute the remaining fabrication activities?

Documentation

9. Is the DECam documentation required by DOE Order 413.3A for CD-3b complete?
10. Have the CD-2 documents been updated to reflect any changes resulting from the final design?

Finally, the committee is requested to present findings, comments, and recommendations at a closeout meeting with DES, Fermilab, NCSA/UIUC, and CTIO/NOAO management and provide a written report within one week after the review.

Appendix B

Agenda

Directors' Review of the Dark Energy Survey Project
August 21-22, 2008

All Meetings in the Black Hole (WH2NW)

Start	End	Time	Subject	Presenter
			Thursday, August 21	
8:00 AM	8:30 AM	0:30	Executive Session	
8:30 AM	8:45 AM	0:15	Welcome and Laboratory Overview	Pier Oddone
8:45 AM	9:15 AM	0:30	Overall DES Status	John Peoples
9:15 AM	9:30 AM	0:15	**BREAK**	
9:30 AM	10:15 AM	0:45	DECam	Brenna Flaugher
10:15 AM	10:45 AM	0:30	DESDM	Joe Mohr
10:45 AM	11:15 AM	0:30	CFIP	Tim Abbott
11:15 AM	12:15 PM	1:00	DECam Breakout on CCDs, FEE and SISPI	Diehl, Shaw, Thaler, Honscheid
12:15 PM	1:15 PM	1:00	**LUNCH**	
1:15 PM	3:00 PM	1:45	DECam Breakout on CCDs, FEE and SISPI	Diehl, Shaw, Thaler, Honscheid
3:00 PM	3:30 PM	0:30	**BREAK**	
3:30 PM	5:30 PM	2:00	DECam and DES Management Breakouts (~ 1hr each, DECam will be first)	Flaugher, Merritt, Peoples
5:30 PM	6:30 PM	1:00	DECam Breakout on Opto-Mechanics, CFIP/DECam installation	Stefanik, Abbott
6:30 PM	8:30 PM	2:00	Working Dinner for Reviewers and Executive Session	
			Friday, August 22	
8:00 AM	9:00 AM	1:00	DECam Breakout on Optics, with additional time for questions on Opto-mechanics and or CFIP/DECam	Doel, Abbott, Stefanik
9:00 AM	10:00 AM	1:00	DESDM - Short Status Reports #1	
		0:10	Management	Beldica
		0:10	Processing Framework	Daues
		0:10	Archive and Data Access	Cai
		0:10	Astronomy Codes	Darnell
10:00 AM	10:30 AM	0:30	**BREAK**	
10:30 AM	11:30 AM	1:00	DESDM - Short Status Reports #2	
		0:10	WL Pipeline	Jarvis/Sheldon
		0:10	Code Release and Repository	Adams
		0:10	Simulation	Lin
		0:10	Calibration	Tucker
11:30 AM	4:00 PM	4:30	Executive Session, Write-up and Dry Run with Working Lunch	
4:00 PM	5:00 PM	1:00	Closeout	

* Notes Breakout Session Lead

Appendix C

Report Outline and Reviewer Writing Assignments

Directors' Review of the Dark Energy Survey Project
August 21-22, 2008

Executive Summary	Ed Temple
1.0 Introduction	Dean Hoffer
2.0 DECam	
2.1 CCDs 2.2 Front End Electronics 2.3 Survey Image System Process Integration (SISPI)	Ron Lipton Hogan Nguyen
2.4 Opto-Mechanics	Tom Peterson Alan Uomoto
2.5 Management, including Cost and Schedule	Elaine McCluskey Nancy Grossman
3.0 DESDM: Data Processing and Data Management	
3.1 Technical Progress/Plans	Raymond Plante Brian Yanny
3.2 Management, including Cost and Schedule	Bill Boroski Brian Yanny
4.0 Facilities Improvment Project (CFIP)	
4.1 General 4.2 Installation	Alan Uomoto Bill Boroski
5.0 Overall Project Management including IPS and Configuration Management	Bill Boroski Alan Uomoto Elaine McCluskey Nancy Grossman
6.0 Charge Questions	
TECHNICAL	
6.1 Is the final design sufficiently mature so that the project can initiate procurement and fabrication? 6.2 For those elements that are not finalized, has the project convincingly shown that there are no major issues that need to be addressed and that they have a clear path forwards toward final design?	Tom Peterson Elaine McCluskey
BASELINE COST AND SCHEDULE	
6.3 Are the current project cost and schedule projections consistent with the approved baseline? 6.4 Are the allocations of contingency adequate for the risks?	DECam: Elaine McCluskey DM & CFIP: Bill Boroski
MANAGEMENT	
6.5 Is the management structure adequate to deliver the proposed final design within specifications, budget and schedule? 6.6 Has the project responded satisfactorily to the recommendations from the previous review?	DECam: Elaine McCluskey DM & CFIP: Bill Boroski

FABRICATION	
6.7 Has there been adequate progress on the fabrication activities approved under CD-3a? 6.8 Is the project satisfactorily prepared to execute the remaining fabrication activities?	OPTO Mechanical: Alan Uomoto Other: Hogan Nguyen
DOCUMENTATION	
6.9 Is the DECam documentation required by DOE Order 413.3A for CD-3b complete? 6.10 Have the CD-2 documents been updated to reflect any changes resulting from the final design?	Nancy Grossman

*Note underlined names are the primary writer.

Appendix D

Reviewers' Contact Information

Directors' Review of the Dark Energy Survey Project
August 21-22, 2008

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Appendix E

Participant List

Directors' Review of the Dark Energy Survey Project
August 21-22, 2008

Role	Last Name	First Name	Affiliation
Collaborator	Kron	Richard	University of Chicago
DES Project	Abbott	Tim	CTIO/NOAO
	Adams	Darren	U of I Champaign/Urbana
	Annis	Jim	FNAL
	Beldica	Cristina	U of I Champaign/Urbana
	Buckley-Geer	Liz	FNAL
	Cai	Dora	U of I Champaign/Urbana
	Cease	Herman	FNAL
	Choong	Ngeow	U of I Champaign/Urbana
	Darnell	Tony	U of I Champaign/Urbana
	Daues	Greg	U of I Champaign/Urbana
	DePoy	Darren	Ohio State University
	Diehl	Tom	FNAL
	Doel	Peter	UCL
	Estrada	Juan	FNAL
	Finley	David	FNAL
	Flaugher	Brenna	FNAL
	Frieman	Josh	FNAL/Uchicago
	Gutierrez	Gaston	FNAL
	Honscheid	Klaus	Ohio State University
	Karliner	Inga	U of I Champaign/Urbana
	Knapp	Dale	FNAL
	Lin	Huan	FNAL
	Merritt	Wyatt	FNAL
	Mohr	Joe	U of I Champaign/Urbana
	Peoples	John	FNAL
	Shaw	Terri	FNAL
	Smith	Chris	CTIO/NOAO
	Stefanik	Andy	FNAL
	Thaler	Jon	U of I Champaign/Urbana
	Tucker	Doug	FNAL
	Walker	Alistair	CTIO/NOAO
Directorate	Garbincius	Peter	FNAL
	Kim	Young-Kee	FNAL
	Oddone	Pier	FNAL
DOE SO	Carolan	Pepin	DOE SO
	Livengood	Joanna	DOE SO
	Philp	Paul	DOE SO
FNAL/CPAF	Hogan	Craig	FNAL
FNAL/PPD	Bock	Greg	FNAL

FNAL/PPD	Lindgren	Mike	Fermilab
	Wilson	Peter	Fermilab
NCSA Directorate	Crutcher	Richard	NCSA
	Dunning	Thom	U of I Champaign/Urbana
NOAO	Walker	Alistair	NOAO
Reviewers	Boroski	Bill	Fermilab
	Grossman	Nancy	Fermilab
	Hoffer	Dean	Fermilab
	Lipton	Ron	Fermilab
	McCluskey	Elaine	Fermilab
	Nguyen	Hogan	Fermilab
	Peterson	Tom	Fermilab
	Plante	Raymond	UIUC
	Temple	Ed	Fermilab
	Uomoto	Alan	Observatories of the Carnegie Institute
	Yanny	Brian	Fermilab

Appendix F

Table of Recommendations

Directors' Review of the Dark Energy Survey Project
August 21-22, 2008

#	Recommendation	Assigned To	Status/ Action	Date
	2.0 DECam			
	2.1 CCDs			
1	The collaboration should make sure that ESD precautions have been communicated to all silicon processing vendors. The collaboration should explore implementing a change-control protocol with the vendors. For example, the processing vendors should document all the processing changes to personnel, equipment repairs, upgrades, or maintenance. If possible, the vendors should notify the collaboration of changes before they take place.			
2	The collaboration should make sure that exhaustive analysis of power-failure scenarios that could damage the CCDs are made. This is on a par with what HEP collaborations have done with their silicon devices.			

#	Recommendation	Assigned To	Status/ Action	Date
3	CCD/Integration - A person should be identified with the responsibility for coordination of the integration and testing of CCDs, hardware, and SISPI software in Lab A and beyond.			
	2.3 Survey Image Process Integration			
4	The project should define explicit goals for integration and testing of software components working with either existing hardware or hardware emulators. Integration of the SISPI system in the Lab A tests, including specific goals, should be aggressively pursued.			
	2.4 Opto-Mechanics			
5	Due to the importance of vendor oversight for the hexapod, continue to work closely with ADS.			
6	Refine the description of a design as "preliminary" either with specifics or with a definition such as the one commented above.			
7	Following completion of analysis of the Cerro Tololo vibration data and measurements of vibrations in the cooling system at Lab A, review again implications, if any, for the cooling system.			
8	Add small edge chips on a lens as a risk. Add small edge chips on a lens as a risk.			
	2.5 Management, Including Cost & Schedule			
9	Utilize a change log and consider sign off approvals for critical design documents which should have been under configuration control since the baseline, such as the Dark Energy Camera Specifications and Technical Requirements.			

#	Recommendation	Assigned To	Status/ Action	Date
10	Update Risk Accounting Forms by the DOE/NSF CD-3b Review to address progress made in R&D, new mitigation options, and any new risks discovered in bi-weekly meetings covering risks/issues and include the date of this update.			
11	Update the Risk Accounting Form and Risk Registry by the DOE/NSF CD-3b Review such that they specify the risk owner.			
	3.0 DESDM			
	3.1 Technical Progress/Plans			
12	Presentations of a Data Challenge would benefit from a summarizing table of the goals of the challenge and the extent that those goals were met. We recognize that not meeting goals does not necessarily imply failure; thus, where appropriate a summary of lessons learned would be helpful in evaluating progress.			
13	Given the challenges of funding (particularly with securing contingency), priorities should be assigned to detailed work and deliverables.			
14	Because of the critical importance of measuring and modeling the PSF well, this should be given high priority in the next two challenges. PSF fitting has only recently begun to be addressed by the DESDM Science Team and it needs to be thoroughly tested with simulations as well as on real (BCS) data well in advance of first light. There should be close communication between the Sextractor developer and the simulator and science testers.			

#	Recommendation	Assigned To	Status/ Action	Date
15	In general, the team should consider for the last two data challenges concentrating more on meeting science requirements rather than processing throughput, as the latter appears to be fairly well in hand.			
16	The team should study the performance requirements for supporting science database queries. This analysis should be done separately for internal science goals and those of the external community.			
	3.2 Management, Including Cost & Schedules			
17	Complete the necessary revisions to move the CFIP Project Execution Plan from "draft version 5.4" to "approved."			
18	Fix a minor typo in Table 4 of the DESDM PEP, which contains the management reserve estimation guidelines. Under "DES Labor", the high level risk category is mislabeled as "low."			
19	Improve the clarity of progress, cost and schedule reporting, to a level commensurate with that of the DECam project.			
20	Revise the DM budget projection to 1) accurately reflect the estimated Total Project Cost; 2) include appropriate contingency levels; and 3) accurately identify the budget for the currently-funded level of work.			

#	Recommendation	Assigned To	Status/ Action	Date
21	Table 7 (DM Project Baseline Costs by WBS) in the DM PEP needs to be revised to clarify the data shown. Columns currently identified as "contingency" should be relabeled to indicate that these are actually estimated costs for unfunded work. In addition, a column showing true contingency should be added to the table.			
	4.0 Facilities Improvement Project (CFIP)			
	4.1 General			
22	Be specific in PowerPoint bullets. For example, instead of simply listing the documents needed, make a table of the document names, their due dates, and current status.			
23	Similarly, writing only "Subsystem functional testing" conveys little information. Creating an MS Project schedule that shows where this (and other tasks) fits into the overall CFIP program with links (coordinated milestones) to the DECam delivery will make it easier for reviewers to digest.			
24	Unload details of status into the Gantt chart (e.g., "RA encoder is installed" and "DEC encoder will be installed") and present only significant off-schedule/budget or technically interesting items in the presentation.			

#	Recommendation	Assigned To	Status/ Action	Date
	4.2 Installation			
25	Move quickly to add an inter-institutional task that defines and approves the telescope interfaces and routine installation procedures. Preliminary line runs and a full installation walk-through example are essential to convince reviewers that the instrument change can go smoothly.			
26	Visits by CTIO technical staff to FNAL would be useful in developing the installation and maintenance procedures. The site staff knows what they're comfortable and capable of doing and can provide ideas for some operations. Engaging them early also helps in the actual delivery and installation work since the work requirements will be familiar.			
27	Draft and agree upon an interface document describing typical repair scenarios and expected levels of support from all institutions. Agree upon reporting requirements for minor changes and repairs (one suspects FNAL has infrastructure for this already).			
	5.0 Overall Project Management Including IPS and Configuration			
28	A person responsible for interface control between DECam, SISPI, and the 4-m telescope (and other interface issues) should be installed. This person will handle milestone coordination and reporting between institutions; keep project activities in sync; control interface documents; and identify potential problems.			

#	Recommendation	Assigned To	Status/ Action	Date
29	Incorporate subproject milestones into the IPS, with periodic statusing.			
30	Regular face-to-face meetings between key project personnel to discuss interface issues and common milestones should be held, including regular meetings on-site at CTIO.			