



## Safety Review

April 10-11, 2014

## **Safety Review**

### **Executive Summary**

**Background** – Victor Krabbendam, the Large Synoptic Survey Telescope (LSST) Project Manager, directed that a second project Safety Review be conducted as a follow-up to the one held in August 2013 in Tucson, Arizona. The initial review committee was reconvened as a Safety Council on April 10-11<sup>th</sup>, 2014. The review committee consisted of the following individuals, Richard Hislop - Hislop & Associates, Inc., Charles Hoes – Hoes Engineering and Mark Grushka - MJGrushka Consulting.

### **Charge to Review Committee**

The Charge to the April 2014 Safety Council was to:

- 2.1 Determine if the safety actions and strategy of the LSST Project Office are effective and adequate for the project at this time on the project schedule.
- 2.2 Review the Dome system process and determine if the Telescope and Site Subsystem group has satisfactorily incorporated the Hazard Analysis and other safety management processes.

### **Assessment Report**

#### **3.1 Effectiveness of the LSST Project Office safety actions and strategies:**

The Safety Council determined that the safety actions and strategies of the LSST Project Office are effective. Specific evidence of this are reflected, as an example, in the manner in which the project addressed the three safety recommendations during the August 2013 Safety Review. Those recommendations were:

1. The LSST Project will require a well-structured systems safety training program to normalize the team member's understanding of the requirements within the LPM-49, LSST Hazard Analysis Plan. The Project should include this training in its project schedule to inform project team members of their role in the development of the Hazards Analysis Plan.
2. Appoint of a full time safety manager for this project before the final design review.
3. The committee recommends that the Systems Engineering group currently managed by George Angeli be given resources and accountability to be "clearing house" for the project Hazard Analysis Register.

Hazards Analysis Strategy - The project has established clear safety processes that includes comprehensive policies and procedures documented in a dedicated website to manage project design hazards. The project policies and procedures clearly assign administrative and managerial responsibilities for the incorporation of a Hazards Analysis Process into the project design scheme. The Project is using Mil-STD-882D, US DOD Standard Practice for System Safety, as a resource for its hazards analysis approach which appears to be clearly understood by the project team members. The project team demonstrated knowledge and process of documenting the identification of safety hazards and risks and their methodology of tracking that information and the integration of hazard mitigation controls into the conceptual design, during the review.

Specific topics addressed during the review that supported these conclusions were;

1. Formal Dome Hazard Analysis
2. Safety and Health Questionnaire in the Bid Contract for the Dome Procurement
3. Contractor Expectations Defined in the LSST Safety Policy LPM-18

Safety Manager - The project now has a full time safety manager in place. Mr. Chuck Gessner was appointed to the role of Project Safety Manager on January 6, 2014. He reports to Victor Krabbendam, Project Manager and devotes full time to providing both organizational and technical safety leadership to the Project. He is a member of the Procurement Committee and Change Control Board and has begun to conduct quarterly visits to Chile to provide on-site safety support.

Hazards Analysis Register Accountability - Each System Group Leader has been charged with the responsibility of managing their respective Hazards Analysis Registers. Through the integration of a computer tracking system called "JIRA", Chuck Gessner and Victor Krabbendam monitor the development of mitigation controls for identified project hazards and risks being developed during the Conceptual Design. Change Control Board has been established to manage the information and data associated with changes impacting safety being proposed for all major and sub-systems.

The project strategy includes the requirement that the successful Design-Build contractor comply with the following requirements:

Implement a formal Hazard Analysis Process detailed in LPM-49

Establish a Project Execution Plan detailed as in LPM-54 which specifically addresses a formal Risk Management Process (4.3), Safety Management (4.5) and Environmental Plans, Permitting and Assessment (4.11)

Implement a Hazard Register for all major systems and subsystems with the Systems Engineers accountable for them (LPM-49, Section 7)

The LSST Project Safety Management team will participate in the hazards analysis review process with the contractor to assure that sufficient attention and resources are allocated to this effort. This appears to be an effective resolution to the Safety Council recommendation in regard to hazards analysis.

The Safety Council believes that given the strength and experience of the LSST project management team, plus the detailed conceptual design of the project that the Design-Build strategy the project has chosen to adopt is appropriate for the nature of this project. The clear safety direction being provided by Mr. Gessner and the very specific Chilean national safety requirements provide an excellent foundation for a successful construction safety program.

*Future Project Safety Staffing* - In regards to future developments of the LSST safety program and staffing, the LSST proposes to have at least two safety engineers dedicated to the LSST Project. In addition the LSST will have access to the AURA-O Safety Engineer who will provide oversight and regulatory interaction in Chile. There is a project budget line item for 1/2 FTE (Safety Manager) supplied by NOAO until 2018. The current Chilean site and safety manager, and AURA-O's safety engineer will provide field safety oversight while the limited site work is conducted this year. The current project staffing plan includes provision for a full time Chilean construction safety professional who will be on site in 2018 when there will be multiple contractors on site.

*Summary* - It is the assessment of the Safety Council that the safety actions and strategy of the LSST Project Office are effective and adequate for the project at this time on the project schedule.

### **3.2 Assessment of the Dome Hazard Analysis.**

The risk management process is being used for the telescope Dome are appropriate for the early stages of a project at the Conceptual Design stage. However, these should be updated to be more specific as more detailed system information becomes available. Currently the descriptions of the hazard scenarios contained in the hazard log tend to be too general. It is important that the descriptions be clear and complete enough to allow the identification and implementation of mitigations.

Currently the mitigations described in the hazard log tend to focus on single solutions. This is appropriate where the identified hazard can be totally eliminated through modifying the design. In situations where the hazard cannot be totally eliminated a system of hazard controls is required. In general, where the hazard cannot be eliminated, it is necessary to provide a system of hazard controls including several of the elements of the hazard control hierarchy such as physical guards, warning devices, training, safety procedures, etc. These should be identified in the hazard log so that they can become a part of the overall design specification for the hardware, software and documentation package.

The current scope of the hazard analyses is focused on hazards that are anticipated during the operation of the completed system. However, the scope of the hazard identification efforts should be expanded to include other phases of the project, including construction, maintenance, and emergency (or unanticipated) conditions. Addressing these lifecycle phases early in the design process enables the design team to mitigate them rather than waiting until the need arises when the facility is in operation and then attempting to find suitable solutions.

Just as the project team has stated it will do, there must be an ongoing collaboration between the Design-Build contractor and the LSST Project Team during the contractor's design process to ensure that elements required for safely constructing the system are incorporated into the design as appropriate. Emphasis should be placed on this expectation of LSST's active role in the hazards analysis and mitigation process during the contractor selection process to assure that the successful bidder has the competency and capacity of address this design expectation.

The LSST Project Team should expect the hazard log developed by the Design-Build contractor to track mitigation features through to final implementation and verification. Each identified hazard must clearly identify the specific mitigation elements which should then be tracked as an integral part of the project management process. Required tests, inspections, or other verification techniques should be clearly identified so that they can be incorporated into the overall project management process. The "what, when and how" for the verification of each mitigation requirement should be specified in as much detail as is practical. The mitigation specifications can start out as general statements, but should be updated and become specific as more information becomes available and incorporated in the "JIRA" system.

The iterative nature of the hazard analysis and hazard tracking process gives rise to the need to continually monitor the design activities, participation in design change discussions, updating and clarifying hazard control specifications, reviewing and commenting on documentation, procedures and training programs, and many other on-going tasks. The Design-Build contractor will need a dedicated staff from each engineering specialty and experienced safety engineers to meet the requirements for the design on a project of this size.

*Summary* - The Safety Council believes that the Telescope and Site Subsystem group has satisfactorily incorporated the Hazard Analysis and other safety management processes into its design effort and is well positioned and informed to clearly define the expectation for this process to the Design-Build contractor during the contractor selection process.

## **Conclusion**

The LSST project has done an excellent job of incorporating safety into the project using a systems safety approach. Leadership clearly supports the value of

establishing this systems safety approach for managing project risk through specific expectations and ongoing actions. The team members are clearly engaged in aligning their work breakdown process using the principles and practices to effectively demonstrate their involvement in safety in their respective areas of expertise in the project.

The Safety Council looks forward to the Design-Build contractor selection process and the project's development of solutions such as fall protection issues in the Dome structure.