Corrective Action Programs

Fixing safety problems—and keeping them fixed

By James J. Loud

SOMETIMES GOOD is just not good enough. Los Alamos National Laboratory (LANL), a leading research institution, has a respectable (and in recent years greatly improved) overall worker safety record. Still, the laboratory's fame as the home of the atomic bomb, plus routine high-hazard operations involving radioactive materials, high explosives, as well as a wide range of top-secret activities, can make virtually any misstep front-page news. In such an environment, safety and security lapses—especially repeat deficiencies—must be held to the absolute minimum.

This article describes how the site established its corrective action program in order to eliminate repeat accidents and incidents. Employees and customers were involved in its creation from the start. Much more than a tracking system, this program includes steps to ensure that all relevant issues are not only captured in a centralized database, but also are effectively managed from discovery to closure and demonstrated effectiveness. The program also contains provisions to ensure that management is proactively and directly involved in finding solutions to its own problems and that lessons learned from any incident are shared with other laboratory facilities and organizations to prevent recurrence. When fully implemented, the corrective action program is expected to play a key role in establishing a "find and fix" culture and in promoting continuous improvement throughout the laboratory.

The Laboratory

LANL sits on nearly 40 square miles of remote and scenic high country in northern New Mexico. Operated by the University of California since its inception during the Manhattan Project more than 60 years ago, the laboratory is currently home to approximately 12,000 employees, students and contractors. Its annual budget exceeds $2 billion. Although its mission remains focused on national security and defense, LANL conducts diverse activities—ranging from high-performance computing to cutting-edge bioscience and biotechnology. Recent accomplishments include computer modeling to help determine the origins of HIV (as well as the genetic foundation for a potential vaccine) and forensic assistance in the investigation of anthrax bioterror attacks.

From 1997 to 2001, the site reduced its accident rate by a factor of three. Total recordable injuries dropped from above 6.0 to less than 2.0, with lost-time injuries declining from approximately 4.0 to 1.0. This improvement is generally attributed to sustained management attention and several safety initiatives collectively labeled "integrated safety management."

Despite these positive trends, the performance still was not good enough. Progress began to plateau in late 2002, and several accidents and incidents seemed all too similar to previous events. Repeat incidents, especially those related to poor adherance to work procedures and insufficient management attention to work activities, continued to occur. Both laboratory management and the Dept. of Energy (DOE), which oversees the site, realized that too many problems were not being corrected.

Incident investigations, and internal and external assessments further indicated that corrective actions for identified problems often focused on symptoms rather than root causes. Failure to identify and act on lessons learned, overdue corrective actions, and weak trending and analysis of problems were identified as programmatic weaknesses extending over a period of several years. To reduce the number of recurring accidents and incidents, additional line management involvement in solving its own problems and improved corrective action follow-up were essential.

Fixing the Fixes

Once the need for a more effective corrective action program was acknowledged, LANL took several proactive steps to ensure that problems were both captured and eliminated. As a first step, an organizational "owner" for the program was established. The Performance Surety (PS) Div. was established in 2002 to consolidate various performance assurance functions such as self-assessment, performance indicators, issues management and quality assurance, which were previously scattered across various laboratory organizations. The division was then tasked with developing a comprehensive site-

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wide corrective action program. The goal was to develop a system that not only incorporated elements of existing "best-in-class" programs, but also engaged and empowered employees to design their own program for fixing problems. Four steps were considered essential to successful program development and implementation.

Get Employees to Design the Program

Ultimately, employees make a safety program succeed (NSC 56). Having employees help develop their own standards and procedures promotes their involvement and buy-in. Employees from a cross-section of the laboratory were recruited to join a focus team, which was charged with developing the institutional procedures necessary to properly identify and implement effective corrective actions. Team members included experts in safety, quality assurance, operations and related disciplines. Representatives from line organizations responsible for program implementation were also on the team.

Learn from the Best

One member of the focus team was assigned to review and visit "best-in-class" corrective action programs to identify successful strategies applicable to LANL. Fluor-Hanford from the DOE complex and the Tennessee Valley Authority's (TVA) commercial nuclear power program were selected. Both groups provided their time, procedures and suggestions to help the laboratory define its program.

This benchmarking activity helped the focus team identify common and critical elements for effective corrective action management:

- Establish a single corporate tracking system for all corrective actions.
- Ensure that management is directly involved in fixing its own problems.
- Prioritize issues and actions to help management concentrate on the most important problems.
- Provide trained institutional facilitators to support and provide consistency for the corrective action program.
- Ensure that corrective actions address root causes.

Determine What the Customer Wants

After incorporating input from Fluor-Hanford and TVA, the focus team drafted corrective action procedures. Although the team included several members from principal line customers (i.e., users), only a few such groups could be represented. Therefore, the draft procedures were also sent for comment to every laboratory line and support organization (more than 30) as the target customers for the program. Dozens of customer comments were received, then resolved during a series of meetings with the commenting organizations. The issues management program procedure was subsequently established on June 30, 2003.

To refine the program, PS Div. collaborated with DOE to arrange a visit from the Institute of Nuclear Power Operations (INPO). INPO is a nuclear utility oversight (and assistance) group formed in 1979 shortly after the Three Mile Island (TMI) accident to bring effective self-regulation to the commercial nuclear power industry. Failure within that industry to take effective corrective action in response to precursor events, including inoperative pressure relief valves, was considered a principal cause of the TMI incident. As a result, effective corrective action programs with strong lessons-learned components became an expectation for the commercial nuclear industry.

INPO provides performance objectives and criteria for effective corrective action programs and routinely evaluates nuclear facilities against those criteria (INPO 25). Since its inception more than 20 years ago, the number of events significant from a nuclear safety perspective (especially repeat events) has declined steadily (Evans 1). In the case of LANL, the institute was asked to review and suggest improvements and implementation strategies for the corrective action program. Based on INPO recommendations, a comprehensive action plan was developed to refine the program.

Help Make It Happen

Few laboratory organizations had substantial experience with effective corrective action management. Some lacked even simple systems to track required actions and commitments. These organizations needed help to implement a program that essentially represented a new way of doing business. To address this and ensure institutional consistency throughout the process, PS Div. established the new position of issue coordinator. This function plays a central role in the corrective action program. In addition to providing routine guidance and assistance in all areas of corrective action management, the issue coordinator:

- identifies issues from various data streams;
- identifies and eliminates duplicate actions;
- screens issues for escalation due to institutional and/or regulatory significance;
- identifies and disseminates lessons learned, best practices and noteworthy accomplishments;
- manages the change control process for corrective action modifications (action due date revisions, etc.);
- assigns corrective action owners to unassigned issues and resolves ownership disputes;
- elevates significant and generic issues to appropriate levels of management;
- facilitates closure verification for selected issues;
- facilitates effectiveness of closure reviews for selected corrective actions;
- assists in formal root-cause analyses;
- obtains feedback from corrective action program users to drive continuous improvement.

Having employees help develop their own standards and procedures promotes their involvement and buy-in.

Corrective Action Essentials

Corrective action management is a fundamental management tool and is vital to continuous improvement efforts. Effective resolution of issues requires a formal process to ensure that concerns are identified and captured, then evaluated for scope and significance, and that corrective actions are developed, tracked and implemented to prevent recurrence. The many meetings, extensive research, and benchmarking and review revealed that certain elements were essential to effective corrective action management.

Many actions had focused on symptoms such as "failure to follow procedure," rather than on root causes that allow the symptoms to persist.

Institutionwide Tracking System

Organizations within the laboratory had a wide variety of systems for capturing and tracking corrective actions. In some cases, no formal system was in place. Those systems in place often used differing criteria to determine which issues to track and how those issues were categorized in terms of significance. Due to these gaps in information and criteria inconsistencies, LANL was unable to effectively perform comprehensive trending, identify laboratorywide lessons learned or provide appropriate management oversight for all significant problems. Similar issues at both TVA and Fluor-Hanford had led them to mandate single organization-wide tracking systems.

Like most businesses, laboratory corrective action commitments are in competition for finite budget resources. That said, all should agree that scarce resources must address what is most important to the organization as a whole. Therefore, it is necessary to view all significant issues/actions in one place so that managers can make informed budget decisions.

To address the institutional need for knowledge and provide the capability for overall management of corrective actions, the issues management program mandates use of a specific tracking system (I-Track) to capture all corrective actions and issues (that meet standardized significance criteria). I-Track is a readily accessible web-based system based on a Lotus Notes (IBM) platform. It not only tracks issues and actions but generates various reports, including overdue actions by organization. In addition, the system automatically sends an e-mail to personnel when they are assigned actions, and sends a reminder if those actions become overdue. Action owners with delinquent items continue to receive automated reminders until actions are closed or due dates are modified.

Significance Prioritization

High-consequence corrective actions require more analysis and management oversight than simple fixes for low-consequence actions. Higher significance levels require an increasing level of rigor and management attention as well. Recognizing this and following the lead of Fluor-Hanford and TVA, LANL established four significance levels to help rank order its issues and associated corrective actions. Issue coordinators help laboratory organizations assign significance levels to ensure site-wide consistency.

- **High:** Severe potential risk that poses imminent hazard to worker safety and health, the public, the environment, security, regulatory compliance, facility operations and/or program/business.
- **Medium:** Moderate potential risk that poses a hazard to worker safety and health, the public, the environment, security, regulatory compliance, facility operations and/or program/business.
- **Low:** Minor potential risk that poses a low-level hazard to worker safety and health, the public, the environment, security, regulatory compliance, facility operations and/or program business.
- **Minimal:** Issues of very low risk potential that may be tracked as discretionary improvement opportunities or because regulations require such records.

Before these levels were established, all laboratory corrective actions were grouped together without regard to importance. Thus, it was not possible to determine which action deserved priority implementation; furthermore, no criteria were in place to determine which actions required additional rigor, such as a structured root-cause analysis, formal change control or an effectiveness review following implementation.

INPO criteria require that corrective actions be prioritized, evaluated and addressed commensurate with their importance (INPO 25). Additional rigor for critical issues/actions is extremely important, but it is also resource-intensive. Most issues and actions require only that they be resolved and reviewed for lessons learned and trending purposes. Targeting low-significance issues is not cost-effective and consumes resources needed for more serious problems. Table 1 shows the laboratory's "graded approach" of required rigor for issues and associated corrective actions based on their significance levels.

Root-Cause Analysis

Root causes must go beyond quick fixes to identify why existing systems allowed the failure to occur (Livingston, et al 3). PS Div. reviewed previously closed corrective actions and found that many actions focused on symptoms, such as "failure to follow procedures," rather than on root causes that allow the symptoms to persist. INPO's visit also revealed that most laboratory corrective actions failed to consider "human performance" root causes, such as weaknesses in organizational safety culture, elimination of error precursors and self-checking.

To address these weaknesses, formal root-cause analyses conducted by qualified employees are now required for all high and medium significance issues. Organizations may select the most appropriate root-cause process from acceptable methodologies. These include event and causal factor analysis; causal tree analyses such as management oversight and risk tree (MORT); and proprietary programs such as TapRooT. To ensure effectiveness and validity, at least one incident investigator must be "certified" in the process used. PS Div. provides trained and experienced root-cause analysts to help perform these investigations. Root-cause codes are also assigned to issues in the I-Track database to help categorize them and facilitate trending and analysis.

Follow-Up

Given the noted weaknesses in root-cause determination, it was not surprising that the review of closed corrective actions found many closed actions that had not actually corrected their targeted problems. This review, as well as industry best practices, demonstrated that a follow-up process is necessary in order to have some confidence that corrective actions are closed appropriately and actually fix problems. Effective follow-up should also prevent the repetition of failed projects by providing historical records of action plans that did not work (Robitaille 49). The laboratory's process now includes

Table 1

Issues Management Requirements Matrix

Activity	Issue Significance Level			
	High	Medium	Low	Minimal
Assignment of responsibility for resolution	Issue owner*	Issue owner*	Issue owner*	Issue owner*
Root-cause analysis	Required†	Required†	Optional‡	Optional‡
Root-cause coding	Required	Required	Optional	Optional
Analysis and action plan development	Issue owner	Issue owner	Issue owner	Optional
Approval of action plan	Required	Required	Optional‡	Optional‡
Tracking of actions to closure in I-Track	Required	Required	Required	Optional‡
Documentation of closure	Required	Required	Optional‡	Optional‡
Validation of effectiveness of resolution	Required	Required	Optional‡	Optional‡
Trending, analysis, synthesis of data and reporting	Quarterly by issue coordinator or as required by senior managers	Quarterly by issue coordinator or as required by senior managers	Quarterly by issue coordinator or as required by senior managers	N/A
Corrective action change control	Required for all issues	Required for institutional or external issues	Required for institutional or external issues	Required for institutional or external issues
Independent review of closure	Responsibility of issue coordinator on select samples of issues or as required by external agencies	Responsibility of issue coordinator on select samples of issues or as required by external agencies	Optional‡	Optional‡

**All activities are the overall responsibility of the issue owner unless otherwise indicated; however, issue owners may, as required, formally delegate specific actions. Actions for required activities must be documented in I-Track.*

†Assistance for root-cause analysis may be obtained from the issue coordinator.

‡Optional unless required by external agency.

a follow-up provision to ensure that closures are verified and that closure documentation is adequate. PS Div. also performs or initiates random independent closure verifications for high-significance issues and for lower-significance issues as required.

Taking corrective action does not guarantee that a problem will be fixed, regardless of the documentation quality. For serious accidents and incidents, management must be confident that actions taken will prevent recurrence. Although other organizations (such as LANL's internal assessment group) may be assigned to evaluate closed corrective action effectiveness, PS Div. initiates effectiveness verification reviews for all closed high-significance issues to determine whether the actions taken actually fixed the problems identified. Where problems are found to persist, new actions are identified and entered into the corrective action management system.

Management Involvement

Top management must set expectations that problems will be identified and corrected. Goals must also be set regarding status indicators such as timeliness of corrective action, number of open/overdue actions and issue recurrence. Best-in-class firms monitor progress toward meeting these goals and expectations—and hold employees accountable for doing so.

Lab management recognized that direct personal involvement is the best way to provide the "emotional drive" necessary for safety success (Thomen 29). To align itself with best-in-class companies and to ensure accountability and management involvement, the laboratory established the Nuclear Safety Executive Board (NSEB). Chaired by the laboratory director and populated by his senior management team, NSEB meets at least monthly to review significant accidents, incidents and issues that impact its nuclear operations. Meeting agendas includes a review of corrective action performance metrics (including the status of delinquent corrective actions) and briefings on significant issues and overdue actions. Since this board includes the top manager from each line organization, lessons learned from any laboratory facility or organization are automatically shared with all applicable managers. Additional actions to address lessons learned are assigned as necessary.

Employee Involvement

In reviewing the laboratory's program, INPO noted a relative scarcity of employee-identified issues and corrective actions. Corrective action programs considered "excellent" by INPO routinely have more than 90 percent of their issues generated as a result of floor-level employee input. A significant majority of issues tracked by LANL were "reactive," stemming from either accidents or problems identified by regulators or external assessments. Best-in-class organizations identify and correct problems before they become accidents or incidents. For example, TVA considers its nuclear plants "complacent" if they do not receive large numbers (in the thousands) of potential improvement inputs from their employees each year.

Enhancing Corrective Actions via Management Review

Issue: Hazardous waste in violation of the Resource Conservation and Recovery Act (RCRA) was found in a vacated work area.

Background: With more than 2,000 facilities performing a wide variety of discreet activities, the laboratory has had a long-term problem with "orphaned" hazardous materials after completion of experiments and other work activities. Traditional corrective actions have focused on returning these materials to proper storage and searching for other legacy waste in the area.

Review: Review of this incident revealed that it was the third such event in the last two years. One event had resulted in nuclear safety noncompliance (Price Anderson Admendment Act).

Additional Actions: After NSEB review, it became clear that the issue was not an isolated incident and that fixes needed to address the entire site. Additional actions including communication of expectations for handling legacy waste were needed. As a result, the following additional actions were taken:

1) Representatives from LANL's major divisions met to discuss the incident and achieve buy-in for more comprehensive corrective actions.

2) A legacy waste awareness campaign was designed. It included discussions in established laboratory publications, a presentation at an "all managers" meeting, and a memo to all managers from the laboratory director detailing the problem and his expectations for correction.

3) The usefulness of the laboratory procedure for removal of legacy waste was enhanced and a separate form for vacating office spaces was created.

LANL's issues management program recognizes that employees' work experience and perspectives are particularly valuable in identifying issues, formulating corrective actions and evaluating their effectiveness. Efforts have begun to identify and implement systems to further encourage and facilitate worker input. These actions are expected to lead to a "find-and-fix" culture in which every worker and manager proactively seeks to eliminate barriers to enhanced performance.

Feedback & Improvement

Corrective action management is a feedback-and-improvement process. Lessons and needs identified as a result of accident investigations, assessments and employee input are converted to actions that drive continuous improvement. Feedback on the overall health of the corrective action system is also needed. As noted in *The Corrective Action Handbook:*

> Corrective actions require the same vigilance, uniformity, verification, evidence and record maintenance as any other function within the organization. . . . It (the corrective action program) carries the same need for monitoring and assessment as a project plan, design project or job folder. It's essential to verify that the plan has been implemented (Robitaille 49).

LANL has built feedback and improvement mechanisms into its corrective action program. These mechanisms include periodic independent assessment of implementation effectiveness; metrics to routinely measure the program's health; and regular management review of program progress.

Conclusion

LANL's current corrective action program is itself a corrective action. It was developed as the result of the investigation of recurrent incidents that could and should have been prevented through effective corrective action management. Full implementation of the program began in January 2004 and it has already begun to pay dividends.

DOE's reaction has been positive—especially regarding the quality of new corrective actions and closure documentation. DOE rejection of proposed issue closures was common. In 2002, only four (of several dozen) issues impacting laboratory nuclear activities could be verified and closed by DOE. In 2003-04, more than 60 issues have been closed—without a single rejection. Also notable is the significant increase in self-identified problems placed into the corrective action process. For example, in 2002, only six of 151 "issues" were identified by laboratory personnel. In 2003-04, more than 50 percent were self-identified, indicating a more proactive approach to finding and fixing problems.

Although management oversight of corrective actions has been enhanced, root-cause identification has improved and relations with regulators are better, the corrective action program remains a work in progress. The comprehensive approach used to develop the program and reliance on features from best-in-class programs provides a high level of confidence in its ultimate success.

Even the safest of organizations have accidents, incidents and near-hits on occasion. The best companies proactively encourage their employees to identify opportunities for improvement. The challenge to any organization interested in continuous improvement is to learn from its mistakes and materially reduce the chance of recurrence. The reward is a safer and more effective place to work. ■

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