CONTRACTOR ASSURANCE SYSTEM TASK TEAM

BEST PRACTICES FOR PERFORMING INVESTIGATIONS/CAUSAL ANALYSES WITH CONSIDERATION OF HUMAN PERFORMANCE IMPROVEMENT PERSEPECTIVES

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Principle Contributors to this Document from the Contractor Assurance System

EFCOG SubGroup/Task Team

M. Kirsch, Environment, Safety, Health & Quality, Investigation Program Owner
National Renewable Energy Laboratory
EFCOG Contractor Assurance Group Task Team Lead

L. Dell, Contractor Assurance, Project Manager
Hanford Mission Integration Solutions
EFCOG Contractor Assurance Group Task Team Member

K. Leffew, Contractor Assurance, Quality Engineer Manager
CNS Pantex & Y-12
EFCOG Contractor Assurance Group Task Team Member

Laurie Minton, Senior Quality Engineering Specialist
CNS Pantex & Y-12
EFCOG Contractor Assurance Group Task Team Member

Lisbeth Mitchell, Occurrence Reporting and Cause Analysis Point of Contact
Idaho National Laboratory
EFCOG Contractor Assurance Group Task Team Member

Approved By

N. Barker, Chair, CAS of Boston Government Services
Principal Consultant
EFCOG Contractor Assurance Group Chair

There is almost no human action or decision that cannot be made to look more flawed and less sensible in the misleading light of hindsight. It is essential that the critic should keep himself constantly aware of that fact.
– Anthony Hidden,
Clapham Junction Railway Accident Investigation

SUMMARY:

Task Team 1 set out to identify best practices for performing investigations/causal analyses with consideration of Human Performance Improvement (HPI) perspectives. This was accomplished through sending surveys to various sites across the DOE Complex. Good practices have been identified and are documented in the "Recommendations" section of the report. The team identified the following best practices to share with the Complex:

- Investigation/causal analysis function is centralized within the organization with dedicated investigators/causal analysts, independent of line management
- Participation in a formal process to become qualified to perform root cause analyses and less rigorous apparent cause analysis is required
- HPI fundamentals and tools are integrated in the investigation/causal analysis process

Surveys identified some common challenges:

- Personnel and management recognizing the value of performing investigation/causal analyses.
- Ensuring the right people perform investigations/causal analyses.
- Getting full support from managers who are hesitant to pull employees off their jobs in order to reconstruct an event results in some sites assigning investigation/causal analysis activities as collateral duties.
- The logistics of conducting a complex investigation/causal analysis and capturing technical information while coordinating subject matter experts and personnel involved in an event can lead to difficulties in meeting deadlines.
- Overemphasizing administrative tasks such as report and supporting documentation formatting can result in reduced time for the actual investigation and causal analysis.
- Self-imposed deadlines can result in rushing the investigative/causal analysis process, which reduces the available time for the investigator/causal analyst to conduct interviews, verify facts, conduct site visits, perform the analysis, and author a quality report.
- Involving workers in corrective action development where appropriate.
- Assuring the responsibility for corrective action development lies with the organization that owns the issue or event.

BACKGROUND:

The team developed questionnaires to solicit responses regarding current investigation/causal analysis practices and requested information on what works well and what can be improved. Questionnaires were finalized and sent to facilities throughout the DOE Complex. Thirteen responses were received from the contractors at the Savannah River Site, Idaho National Laboratory, Hanford Site, Los Alamos National Laboratory, Lawrence Livermore National

Laboratory, Nevada National Security Site, Y-12 National Security Complex, Pantex Plant, National Renewable Energy Laboratory, and Brookhaven National Laboratory. A second set of questionnaires more specific to HPI were sent out with 8 responses received. In the aggregate, respondents have several decades of valuable operating experience in performing investigations/causal analyses.

Task Team members reviewed responses and enlisted the assistance of a professional data analysis team to bin and analyze the data.

RESULTS:

Survey results were binned into the following topics:

Culture

Surveys revealed significant progress in creating a positive culture in which people feel they can be open about sharing the less attractive parts of their work experience for the benefit of the DOE Complex, as evidenced by interviewees describing error precursors during investigation/causal analysis activities. As an example, respondents described that interviewees are forthcoming when they make an error, or that they did not have an accurate perception of risk, and therefore used shortcuts when trying to accomplish a goal, even when their actions led to a significant event.

Respondents also found that workers and managers tend to be very open once they understand the investigator/causal analyst is only interested in determining what and why something happened and is not interested in assigning blame. It is important to make the employees feel comfortable to speak candidly because the ultimate goal is to correct the right issue or cause and prevent recurrence.

Scene Preservation

Feedback from surveys suggests that event scene preservation is a strength in the sites surveyed.

Resource Availability

Survey respondents indicated workers are normally available for interviews. Rare instances of lack of availability can be attributed to worker absence due to injury or employees no longer with the Prime or subcontractor. Shift assignments can also add complexity in gaining access to workers. Rarely, subcontract workers are not available due to dismissal after an event. Additionally, Subject Matter Experts (SME) are usually available to talk to investigators/causal analysts, although scheduling time to work with SMEs can sometimes be difficult.

Organizational Considerations

DOE sites that have a centralized investigation/causal analysis structure with dedicated investigators/causal analysts reporting to an appropriate level of management (outside of any line organization they are investigating) present elements of a best practice.

- The appropriate level of management should champion investigators and causal analysts to provide the positional authority needed to be effective.

- Distributed teams conducting investigations/causal analyses for events in lower or mid-level line organizations they report to can be challenged with difficulty in independence and authority that impact their ability to complete high quality, independent investigations and subsequent causal analyses.
- Positive results have been achieved at sites using a centralized model, where investigators/causal analysts are assigned to topical areas because they are familiar with the areas assigned and possess the knowledge, skills, and abilities to handle the investigation/causal analysis process.
- Assigning back-up investigators/causal analysts on a rotating basis provides experience across the site. This allows for greater depth and flexibility in the investigation/causal analysis, as well as facilitating collaboration and team effort.
- Centralized investigation/causal analysis services can provide the additional following benefits:
    - Consistency in the application of Human Performance fundamentals and tools.
    - More experienced investigators/causal analysts because they perform them often.
    - Availability of investigators/causal analysts who are ready to perform investigations and causal analyses across multiple facilities and organizations.
    - Mentoring of newer investigators/causal analysts is easier because of the centralized structure.
    - Investigators/causal Analysts are more readily available for quality/peer reviews, cross training/mentoring, and additional assignments when they were being used to conduct an investigation.
    - Investigation/causal analysis results are more consistent in form, fit, and function, as all investigators/causal analysts are producing reports under the same process, and with similar application of causal analysis and human performance fundamentals and tools.
    - Autonomy is achieved since investigators/causal analysts do not work within the organizations for which they provide services.

At some sites, investigations are conducted separate from causal analyses, which leads to a degradation in the quality of the overall process. Combining those functions is an opportunity for improvement because:

- It is vital to have first-hand information from interviews of persons knowledgeable of the event to ensure a factual and defensible investigation/causal analysis;
- It facilitates better communication across the organization;
- It allows development of better/more effective corrective actions;
- It results in less stress to interviewees/workers by avoiding multiple interviews; and
- It helps alleviate bias.

Use of Human Performance Fundamentals and Tools

In general, respondents use human performance fundamentals and tools such as reactively determining error precursors, examining flawed defenses, and searching for potential organizational and/or programmatic weaknesses.

Some sites have developed human performance improvement tools customized to their organizations. These sites have been asked to share their tools with the appropriate EFCOG working groups.

Training and Qualification

A formal qualification program provides credibility to the investigation/causal analysis program and helps to ensure high quality, timely products.

The use of qualification programs that include the use and understanding of causal analysis tools (e.g. change analysis, barrier analysis, events and causal factors analysis, and fault tree analysis) has proven to be successful in developing investigators/causal analysts. Additional training in topics such as HPI fundamentals and Just Culture, can ensure a well-rounded investigation/causal analysis.

At some sites, personnel who perform HPI investigations outside the causal analysis process are required to hold separate HPI qualifications and some sites certify their causal analysts similar to NQA-1 Lead Auditor type standards.

HPI Integration into Investigations/Causal Analysis

Integration of HPI into investigations/causal analysis processes is standard practice at several DOE sites but is not consistently applied across the Complex. Integration may include an HPI section for the investigator/causal analyst to complete, using HPI to develop lines of inquiry and/or corrective actions, to address not only human performance errors but also underlying conditions that lead to the error. In some cases, the use of HPI fundamentals and tools is integrated into investigative/causal analysis processes.

While this type of integration is becoming more common, there are some sites where HPI fundamentals and tools are not yet part of formal procedures, even though they may be implemented on some level. In many cases, the level of integration can be dependent on the event and the investigators/causal analysts. There is a consensus that, except for the very simplest of analyses, HPI integration is highly beneficial to the processes of event investigation and causal analysis.

Although HPI error precursors were originally designed for proactive use before work begins, they are more frequently used in a reactive manner, such as in investigations and causal analyses. The reasoning for this application is to better understand why the human error occurred with the intent of implementing more effective corrective actions.

RECOMMENDATIONS:

1. Instill a Just Culture and ensure management and investigators/causal analysts understand HPI fundamentals and tools.
2. Use a graded approach to identify the appropriate level of investigation/causal analysis needed for each issue. A graded approach will eliminate the need to dedicate a significant amount of time for lengthy report development for less significant events where simple explanations, identification of cause codes, and corrective actions are sufficient.
3. Encourage a partnership between senior management and investigators/causal analysts to facilitate investigation/causal analysis and ensure management awareness of key issues at the site.
4. Educate the organization on the purpose and importance of good investigations/causal analyses and corrective action programs to the overall health of the organization. This will help managers and employees understand how latent conditions, systemic problems, and human errors contribute to events/issues.

CONCLUSION:

The aforementioned best business practices and recommendations can improve the quality of investigation/causal analysis results across the DOE, while meeting the goal of enhancing mission safety, sharing effective practices to support continuous improvement, and responsible stewardship of taxpayer dollars.

APPENDIX A – DEFINITIONS

Apparent Cause(s): the most probable cause(s) that explains why the event happened, that can reasonably be identified, that local or facility management has the control to fix, and for which effective recommendations for corrective action(s) to remedy the problem can be generated, if necessary.

Best Practice: A practice with redeeming qualities and attributes that has been proven through implementation and would be beneficial for others to use. The term does not mean the best of all similar practices.

Causal Analysis: Use of an approved, structured method by a qualified individual or team to analyze events and conditions in order to identify causal factors and cause(s), so that actions can be taken to prevent recurrence. Causal analysis is performed on a graded approach for major and minor incidents, and near-misses, to identify causes and follow-up actions.

Causal Analyst: An individual who has completed requisite training and activities to become qualified in conducting causal analyses.

Causal Factor: An event or condition in the accident sequence necessary and sufficient to produce or contribute to the unwanted result. A causal factor is a collective descriptive term associated with human performance or a safety management system, which can be broken down to identify direct, root, and contributing causes.

Certification: The process by which contractor management endorses and documents, in writing, the satisfactory achievement of qualification of a person for a position. Certification follows the completion of the qualification program for those positions identified as requiring certification. The notable difference between certification and qualification is that certification requires official contractor management endorsement of an individual's qualification to ensure senior management involvement in the qualification of key operations positions (i.e., operators and supervisors). Other significant differences between qualification and certification are the requirements associated with continuing training, examination, and reexamination for recertification.

Condition: Any as-found state, whether or not resulting from an event, that may have adverse safety, health, quality assurance, operational, or environmental implications. A condition is usually programmatic in nature; for example, errors in analysis or calculation; anomalies associated with design or performance; or items indicating a weakness in the management process are all conditions.

Conduct of Operations: The goal of Conduct of Operations is to minimize the likelihood and consequences of human fallibility or technical and organizational system failures. Conduct of Operations is one of the safety management programs recognized in the Nuclear Safety Rule [Title 10 Code of Federal Regulations (CFR) Part 830, Nuclear Safety Management], but it also supports safety and mission success for a wide range of hazardous, complex, or mission-critical operations, and some conduct of operations attributes can enhance even routine operations. It supports the Integrated Safety Management (ISM) System by providing concrete techniques and practices to implement the ISM Core Functions of Develop and Implement Hazard Controls and Perform Work Within Controls. It may be implemented through facility policies, directives, plans, and safety management systems and need not be a stand-alone program.

Contributing Cause(s): A cause that contributed to an occurrence but by itself would not have caused the occurrence. For example, in the case of a leak, a contributing cause could be lack of adequate operator training in leak detection and response, resulting in a more severe event than would have otherwise occurred. In the case of a system misalignment, a contributing cause could be excessive distractions to the operators during shift change, resulting in less-than-adequate attention to important details during system alignment.

Corrective Action: Measures taken to rectify conditions adverse to quality and, where necessary, to preclude repetition. A corrective action needs to be SMARTS, Specific, Measurable, Accountable, Reasonable, Timely, and Sustainable.

Direct Cause(s): The cause that directly resulted in the occurrence. For example, in the case of a leak, the direct cause could have been the problem in the component or equipment that leaked. In the case of a system misalignment, the direct cause could have been operator error in the alignment.

Event: Something significant and real-time that happens (e.g., pipe break, valve failure, loss of power, environmental spill, earthquake, tornado, flood, injury). Note that an event is also anything that could seriously impact the intended mission of DOE facilities.

Investigation: Timely data collection by a designated person; initial conditions, operator statements, pertinent computer/instrument printouts or charts, pertinent documentation and records, and other appropriate information.

Investigator: Must be trained and qualified, experienced and technically qualified, no bias or vested interest in the results of the investigation; trained in facility systems, operations, and investigation techniques.

Issue: A generic term generally referring to an event, finding, opportunity for improvement (OFI) or other identified condition requiring evaluation, resolution, or response.

Occurrences: Events or conditions that adversely affect, or may adversely affect, DOE (including NNSA) or contractor personnel, the public, property, the environment, or the DOE mission. Occurrences must be investigated and analyzed using a graded approach in accordance with locally approved quality and issues management procedures. Facility Managers must consider the significance or potential significance of the event when choosing the scope and tools to use in the investigation.

Qualification: In terms of education, experience, training, examination, and any special requirements necessary for performance of assigned responsibilities. Qualification requirements are intended to provide reasonable assurance that personnel at DOE Hazard Category 1, 2, and 3 nuclear facilities possess qualifications to operate and maintain the facility safely and reliably under all conditions.

Root Cause(s): The causal factor(s) that, if corrected, would prevent recurrence of the accident. (DOE O 225.1B)

Safety: An all-inclusive term to encompass protection of the public, workers, and the environment (used synonymously with environment, safety, and health). (DOE O 414.2D Chg 2)

APPENDIX B – REFERENCES

Survey responses

DOE G 231.1-2, *Occurrence Reporting Causal Analysis Guide*

DOE-HDBK-1028-2009, DOE Standard, *Human Performance Improvement Handbook, Volume 1: Concepts and Principles*

DOE-HDBK-1028-2009, DOE Standard, *Human Performance Improvement Handbook, Volume 2: Human Performance Tools for Individuals, Work Teams, and Management*

DOE-NE-STD-1004-92, *DOE Guideline, Root Cause Analysis Guidance Document*

DOE O 225.1B, *Accident Investigations*

DOE O 226.1B, *Implementation of Department of Energy Oversight Policy*

DOE O 232.2A, *Occurrence Reporting and Processing of Occurrence Information*

DOE O 414.1D, *Quality Assurance*

DOE O 422.1 MinChg 3, *Conduct of Operations*

DOE O 426.2, Admin Change 1, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*