EFCOG Best Practice #192

Facility: DOE Complex

Best Practice Title: Guide to Incorporating Risk Assessment into Integrated Safety Management for Electrical Safety

Point of Contact: 2015 Electrical Safety Working Group #5 “Risk Assessment”, led by

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Brief Description of Best Practice: This guide provides a tool for understanding the Risk Assessment Process, as defined by the 2015 NFPA 70E, Standard for Electrical Safety in the Workplace, and a method for incorporating risk assessment into Integrated Safety Management.

Why the best practice was used: The DOE/EFCOG Electrical Safety Task Group developed five distinct project areas for improving electrical safety at its 2015 Electrical Safety Workshop in Livermore California. Working Group #5 “Risk Assessment” developed a guide that the DOE Complex can utilize to incorporate the concept of risk assessment into their electrical safety programs.

What are the benefits of the best practice: The guide will be used by the DOE Complex to aid in incorporating risk assessment into their individual electrical safety programs. The guide also provides risk factors and tools that can be used by electrical workers when performing real-time risk assessments.

What problems/issues were associated with the best practice: 2015 NFPA 70E augmented the practice of performing a hazard analysis with a risk assessment process.

How the success of the Best Practice was measured: Success will be measured by the use of this Best Practice into DOE complex electrical safety programs.

Description of process experience using the Best Practice: N/A

Guide to Incorporating the Risk Assessment Process into Integrated Safety Management for Electrical Safety

1.0 Understanding Risk Assessment

Risk Management is not a new concept, although it was first introduced into the 2015 edition of NFPA 70E, Standard for Electrical Safety in the Workplace. The term risk assessment globally replaced hazard analysis throughout the standard. By definition, the term risk includes an aspect of likelihood of occurrence and therefore requires an assessment to evaluate the work that will be performed and estimate the likelihood of how that work could lead to injury or damage to health.

Many papers, standards, and guides have been written to help understand and explain Risk Management. This best practice will focus on how to incorporate the terminology and concepts of Risk Management into how the DOE Complex currently manages electrical safety through the Integrated Safety Management process. References for some of these papers, standards, and guides will be provided at the end of this document.

Fig. 1-1. References to Understanding Risk Management

2.0 Incorporating Risk Assessment into Integrated Safety Management (ISM)

Risk Assessment is an overall process to identify hazards, analyze risk (i.e. estimate the likelihood of occurrence of harm and the potential severity of harm), and evaluate risk (i.e. determine if protective measures are required).

This section describes the process to perform a risk assessment for electrical hazards. It describes how risk assessment can be integrated into the ISM model. The Subtitles in Section 2 are taken from the risk assessment model with the associated step from the ISM model shown in parenthesis following the subtitle.

Prior to beginning work that could involve electrical hazards, a task-based risk assessment must be performed to identify hazards, analyze and evaluate the risk, and identify and document risk control measures.

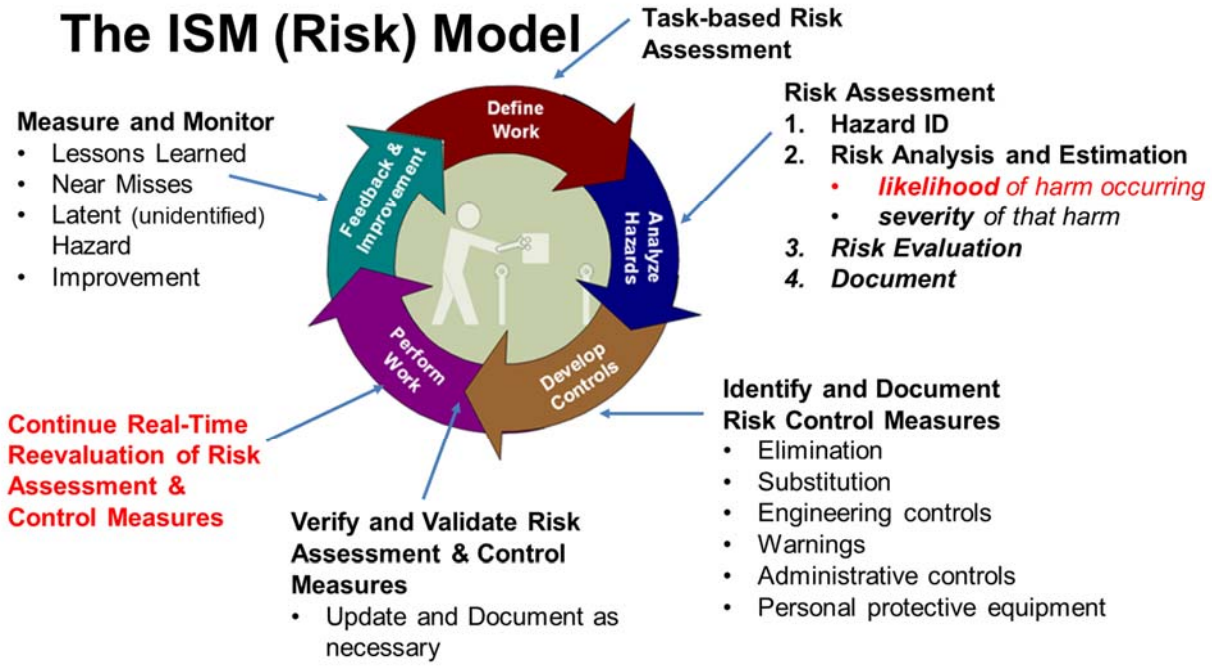


Fig. 2-1. Integrating ISM and Risk Management

2.0.1 Task-based Risk Assessment (Define Work)

The initial ISM step "Define Work" is similar to performing a task-based risk assessment. "Define work" involves clearing identifying scope of work and the tasks necessary to accomplish that scope of work. Similarly, the initial step of a task-based risk assessment involves breaking a job into discrete tasks.

2.0.2 Risk Assessment (Analyze Hazards)

After a job is broken into discrete tasks then the risk assessment proceeds as described in Section 2.0:

1. Hazard Identification: Identify the hazards associated with each task.

   If two or more sequential tasks have the same electrical hazards and a similar level of risk and require the use of similar risk control methods, then it may be possible to merge those tasks and document them as one larger task. However, if sequential tasks have different electrical hazards or a different level of risk or require the use of different risk control methods, then the tasks must be documented as separate, smaller tasks.

   For example, tasks such as working in an Electrically Safe Work Condition (Mode 0), Establishing an Electrically Safe Work Condition (Mode 1), and Performing Energized Diagnostics and Testing (Mode 2) each have different levels of risk and therefore must be documented as separate tasks.

2. Risk Analysis: The risk associated with each hazard is analyzed to establish a level of risk.

   The following factors should be considered when analyzing risk:

   A. Analyze the potential severity of the harm by identifying the hazard class(es) (source(s) of energy) that the worker could be exposed to. The hazard classification system takes into account the potential severity based on thresholds for injury.

   B. Estimate the likelihood of occurrence of harm by identifying how the worker is going to interact with the equipment and how that interaction might result in exposure to hazardous energy. In some DOE complexes the likelihood of occurrence of harm can be defined by the Mode of Work classification system. As the Mode of Work classification number increases, the likelihood of occurrence of harm increases.

   C. Analyze factors that could affect the likelihood of occurrence of harm or the severity of harm, or both (e.g. a shock hazard in a wet environment; an arc flash hazard in a confined space; the condition of the equipment; the condition of the work environment; the condition of the work or workers). Some of these factors are discussed in further detail in Section 3 of this paper.

3. Risk Evaluation: The level of risk is evaluated to determine if additional protective measures are required. One basis for determining whether or not additional protective measures are required is known as the ALARP principle: Is the level of risk “As Low As Reasonably Practicable”? If not, then risk controls are implemented from a hierarchy of methods to reduce the risk to such a level.

2.0.3 Identify and Document Risk Control Measures (Develop Controls)

Evaluate the risk and determine the necessary risk control measures that need to be incorporated. Document the risk and risk control measures in the appropriate work control documentation. This includes performing appropriate shock and arc flash risk assessments.

Risk control measures should be based on the following hierarchy:

- eliminate the hazard,
- substitute with other materials, processes, or equipment,
- incorporate engineered controls,
- increase the awareness of potential hazards by using signage, warnings, and barricades
- utilize administrative controls,
- establish measures to ensure the appropriate selection, use, and maintenance of PPE.

2.0.4 Verify and Validate Risk Assessment & Control Measures (prior to Perform Work)

Perform a pre-job brief to verify that all hazards have been accounted for by the risk assessment and validate that risk control measures adequately reduce the risk to as low as reasonably possible. Evaluate environmental and worker conditions to ensure that additional risk control measures do not have to be incorporated.

2.0.5 Real-Time Reevaluation of Risk Assessment and Control Measures (Perform Work)

During the evolution of the job, always watch for any changes in the equipment, environment, and/or work/worker conditions to ensure that a change does not warrant incorporation of additional risk control measures. Pause work, as appropriate, to ensure that work can continue safely.

2.0.6 Measure and Monitor (Feedback & Improvement)

Upon completion of the job, evaluate lessons learned, near misses, and latent (unidentified) hazards, with an emphasis of improvement for the next job.

3.0 Factors that Affect Risk

Many factors could be considered when evaluating risk. Certain factors could increase the severity of the actual hazard, whereas other factors could increase or decrease the likelihood of occurrence. This section will breakdown factors that affect risk into three categories; Condition of the Work and Worker, Condition of the Environment, and Condition of the Equipment. This section will provide the workers with some factors to consider when performing risk assessment, both during the initial planning stages, validating the controls, and when re-evaluating change in conditions during the job.

3.0.1 Condition of the Work and Worker

The centerpiece of preventing accidents revolves around the worker and their understanding of the work being performed. The following factors should be taken into consideration as part of risk assessment:

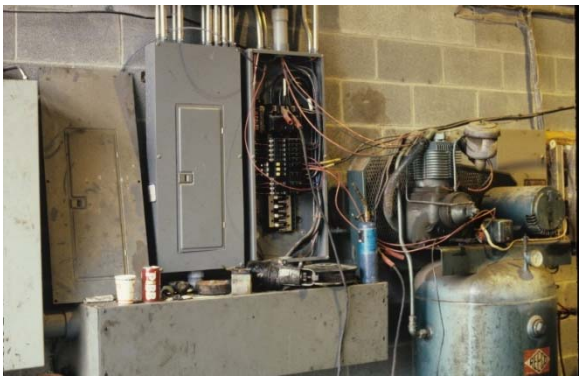
- Qualification and Experience of the worker(s)
  - Mentoring
- Work Schedule or Planning Issues
  - Off Normal Hours, Long Work Hours
  - Changing
    - Scope, Work Plan, Location of the Activity, Work Groups, Concurrent Work Activities
- Understanding of Roles and Responsibilities
- PPE Concerns
- Short Timeline/Time Pressures
- Ergonomics
- Work Turnover
- Communication
- Fit for the Task
- Physically and Mentally Focused

3.0.2 Condition of the Environment

The environment could have a direct impact on the cause of an electrical accident. The following factors should be taken into consideration as part of risk assessment:

- Weather
  - Temperature
  - Water/Moisture
- Infestation
- Lighting
- Noise
- Confined Spaces/Limited Working Space
- Housekeeping
- Radiological Work
- Signage/Barriers
- Conductivity of Work Area

3.0.3 Condition of the Equipment



NFPA 70E has emphasized the importance of considering the conditions of the equipment when evaluating risk and considering controls. The following factors should be taken into consideration as part of risk assessment:

- Accurate Documentation Available
- Installation/Workmanship
- Maintenance
- Age
- Usage/Duty
- Evidence of Impending Failure
- Covers in Place & Secured
- Unused Openings
- Look Alike Equipment

4.0 References

- NFPA 70E: *Standard for Electrical Safety in the Workplace.* Quincey, MA: NFPA, 2015. Print.
- ISO 31000: *Risk Management: Principles and Guidelines – First Edition.* ISO – International Organization for Standardization, 2009. Print.
- ISO 31010: *Risk Management: Risk Assessment Techniques – First Edition.* ISO – International Organization for Standardization, 2009. Print.
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- ANSI/AIHA Z10: "Appendix F." *American National Standard – Occupational Health and Safety Management Systems.* American Society of Safety Engineers, 2012. 47-52. Print.
- MIL-STD-882E: *Standard Practice System Safety.* Air Force Materiel Command Safety Office, 2012. Print.
- Roberts, D.T. IEEE Papers
    - Risk Assessment and your Electrical Safety Program; IEEE IAS Applications Magazine Vol. 22, No. 3; May/June 2016; Page 33
    - Risk Management and Electrical Safety; IEEE IAS Applications Magazine Vol. 21, No. 3; May/June 2015; Page 72
    - Risk Management of Electrical Hazards; IEEE IAS Applications Magazine Vol. 19, No. 3; May/June 2013, page 21

5.0 Attachment A: Integrating ISM & Risk Management Safety Poster

The attached Safety Poster summarizes the Best Practice and can be used as tool for the workers and converted into badge cards or other visual aids for workers.

IMPROVING THE CULTURE ON ELECTRICAL SAFETY

INTEGRATING ISM & RISK MANAGEMENT

FACTORS THAT AFFECT RISK

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- Off Normal Hours, Long Work Hours
- Changing
  - *Scope, Work Plan, Location*
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  - *Concurrent Work Activities*

Understanding of Roles and Responsibilities
PPE Concerns
Short Timeline/Time Pressures
Ergonomics
Work Turnover
Communication
Fit for the Task, Physically, and Mentally Focused

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- Temperature
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Infestation
Lighting
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