

"Risk Assessment", [REDACTED]

subject: **Electrical Hazard Assessment as per NFPA 70E**

ABSTRACT

In accordance with NFPA 70E, a "Risk Assessment" has been performed for the task of electrical test instrument measurement and troubleshooting on energized electrical pump motor starters and fused disconnects, located inside a dedicated electrical building. The methodology and data are discussed, and its analysis is presented. Current work procedures are evaluated as safe, and workers following this procedure are seen as adequately protected from electrical hazards.

INTRODUCTION

The nationwide standard for electrical safety is the document NFPA 70E Standard for Electrical Safety in the Workplace. This standard is revised and republished every three years -- the last three editions were 2009, 2012, and 2015.

OSHA may not specifically enforce NFPA 70E, because NFPA 70E is not "Incorporated by Reference" in 29 CFR 1910.6 . However, OSHA does have several comparable standards that are enforceable. In general, a workplace following NFPA 70E is also in compliance with OSHA standards regarding electrical safety. The same is true for similar standards, codes, and requirements of state and local government bodies, as well as insurers.

One item NFPA 70E requires is a comprehensive workplace "Risk Assessment Procedure":

"An electrical safety program shall include a risk assessment procedure that addresses employee exposure to electrical hazards... The procedure shall identify the process to be used by the employee before the work is started to carry out the following:

- (1) Identify hazards
- (2) Assess risks
- (3) Implement risk control..."(NFPA 70E, Article 110.1(G), "Risk Assessment Procedure")

The above quotation documents the full extent of NFPA 70E's requirements for a "Risk Assessment Procedure". In other words, 70E does not mandate a specific procedure or a boilerplate evaluation form; however, it does provide examples of implementation in an "Appendix":

"For an example of a risk assessment procedure, see Informative Annex F."
(NFPA 70E 110.1(G), "Risk Assessment Procedure", Informational Note No. 3)

Similarly, NFPA 70E Annex F states:

"This informative annex is not a part of the requirements of this NFPA document but is included for informational purposes only."
(NFPA 70E, Annex F)

"Risk Assessment", [REDACTED]

"This informative annex provides guidance regarding a qualitative approach for risk assessment, including risk estimation and risk evaluation..."

(NFPA 70E, Annex F.1, "Risk Assessment (General)")

"Electrical system designers, constructors, and users have responsibility for defining and achieving tolerable risk. The supplier and the user either separately or jointly identify hazards, eliminate risks, and reduce risks to a tolerable level..."

(NFPA 70E, Annex F.1.1, "Responsibility")

Annex F further states that there is no single, exact method to properly assess risk :

"Several methods are available for qualitatively determining risk, such as risk assessment matrices, risk ranking, or risk scoring systems.

(NFPA 70E, Annex F.2, "Risk Assessment", Handbook commentary)

Annex F states that the numerical values used in assessing risk are not measurable but subjective:

"Even though the method used in Section F.2 uses parameter estimates (numbers), it is not a quantitative method of analysis because it does not use measurable, objective data to determine likelihood of loss and objective risk."

(NFPA 70E, Annex F.2, "Risk Assessment", Handbook commentary)

DATA

An "Electrical Hazard Risk Assessment" was begun on March 20, 2015 by P. Dybel and [REDACTED].

This concerned an exemplary case of using electrical test equipment to check operation & troubleshoot an energized 480-volt pump motor starter and fused disconnect, located in [REDACTED] -- in this case for the pump motor at [REDACTED].

The estimated risks were documented in writing on that date. The recorded parameters follow:

"Severity of the Possible Injury or Damage to Health (Se)"

480 Volts is inherently very dangerous; and direct contact can lead to a range of consequences: from a slight tingling, to burns, to heart stoppage and death.

Although these consequences can vary widely, NFPA 70E Annex F recommends using the most severe possible consequence:

"These parameters should be based on worst-case considerations for the electrical system."

(NFPA 70E, Annex F2.2, "Parameters Used in Risk Estimation")

As a result, here this parameter was recorded as "Irreversible (trauma, death)".

"Risk Assessment", [REDACTED]

Frequency and Duration of Exposure (Fr)

An event such as this example (energized motor starter & disconnect, electrical measurement & troubleshooting) occurs perhaps once per week, with an actual exposure time of perhaps three minutes.

The parameter was recorded as "> 1 per day to ≤ 1 every two weeks".

Likelihood of Occurrence of a Hazardous Event (Pr)

On that day, I demonstrated my methodology to [REDACTED]. Before I even approached any energized electrical, I made sure I had the proper PPE (safety glasses, insulated boots, voltage gloves, FR outerwear, etc.). I made sure my test equipment (a Digital Multi-Meter) was operational, undamaged, and appropriate for the voltage range. I made sure all "unqualified" persons ([REDACTED], all [REDACTED]) were outside the designated "limited approach boundary". I made sure no other safety issue was present (flammables, potential traffic, water, etc.).

Only then did I remove the starter enclosure cover, visually assess the equipment, and then measure the voltages at the contactor. I described my testing procedure: "If it reads xxx here, I need to check the 120-volt control wiring. If I get xxx here, it's the contactor, and I need to lock it out to disassemble and repair. If I get xxx here, it's probably the fuses..." Then I opened the fused disconnect above the starter, and showed him how I measure at the fuses, and showed him how I would disconnect the power before I replaced a fuse.

When this procedure is done as above by a qualified person, the likelihood of a hazardous event is "rare" or "negligible". The parameter was recorded as "Rare".

Likelihood of Avoiding or Limiting Injury or Damage to Health (Av)

Again, when done as above by a qualified person, the likelihood of avoiding injury is high. The parameter was recorded as "Probable".

ANALYSIS

A "Risk Analysis" may include a "Risk Assessment Matrix", one example of which is NFPA 70E, Annex F, Exhibit F.1 . This provides simple evaluation of risk based on two values: "Severity of the injury (consequences)", and "Likelihood of occurrence in period".

Column: "Severity of the injury (consequences)"

The parameter for "Severity of the Possible Injury or Damage to Health (Se)" was recorded as "Irreversible (trauma, death)". Therefore, the appropriate "Severity" column is "Catastrophic".

Row: "Likelihood of occurrence in period"

First of all, the "Frequency and Duration of Exposure (Fr)" parameter recorded, "> 1 per day to ≤ 1 every two weeks", is comparable to "Occasional".

"Risk Assessment", XXXXXXXXXX

Next, the "Likelihood of Occurrence of a Hazardous Event (Pr)" parameter was recorded as "Rare", and the "Likelihood of Avoiding or Limiting Injury or Damage to Health (Av)" parameter was recorded as "Probable".

Combining these three values, in a reasonable way, it is appropriate to say that the "Likelihood of occurrence" of an injury is "Unlikely".

Tabulated Risk

Looking up these values in the table, "Catastrophic" and "Unlikely" meet in an orange cell containing the letter "M". This indicates "Moderate Risk". The NFPA 70E Annex F "Commentary Table F.2" evaluates this as a "Tolerable risk" -- in other words, a risk which can be justified if it is truly necessary, but which should be avoided whenever possible.

EVALUATION

NFPA 70E Article 130, "Work Involving Electrical Hazards", gives requirements for energized electrical work:

"Energized work shall be permitted where the employer can demonstrate that the task to be performed is infeasible in a de-energized state..."

(NFPA 70E, Article 130.1(A)(2) "Infeasibility")

Also:

"In many situations... diagnostic work such as voltage measurement, troubleshooting, and testing of electrical equipment is infeasible to perform without the employee being exposed to energized conductors and circuit parts."

(NFPA 70E, Article 130.1(A)(2) "Infeasibility", Handbook commentary)

CONCLUSION

Energized electrical work at these motor starters and disconnects, for the purposes of electrical test instrument measurement and troubleshooting, is a tolerable risk. Although possible consequences can be severe, the likelihood of injury to a qualified person using correct procedures is minimal.

It is recommended that such work be done only by a qualified person; only when necessary and only for as long as necessary for completion of the task; and only in compliance with established procedures and general safety standards.