



Fire or Potential Explosion Risk Assessment Tool

Purpose:

This tool is designed to be used as a resource for initiating or reviewing the risks involving a fire or potential explosion within your process at your facility.

Scope:

This is developed to narrow your focus on each section of your process in such a way that all components of your operation are reviewed for risk potential. The process to be used can follow a typical HAZOP, LOPA or WHAT-IF hazard assessment model, or other such model that your site is familiar with using.

Goal:

This process is used to identify/verify the protective measures that are missing/in place in order to improve on the overall safety and efficiency of the operation.

The overall goal is to eliminate a fire or potential explosion at the site, if there is one, reduce the impact and safely manage the situation so the site can resume regular operation.

Definitions:

HAZOP: A hazard and operability study (**HAZOP**) is a structured and systematic examination of a complex planned or existing process or operation to identify and evaluate problems that may represent risks to personnel or equipment.

WHAT-IF: The What-if is organized using a checklist of questions that begin with "What if". For example, "What if an operator forgot to stop a conveyor?" Each question represents the potential for failure of equipment or error of operating procedure in the facility.

LOPA: Layer of Protection Analysis is a study developed based on a risk identification analysis (e.g. HAZOP). The main purpose of that study is to identify the countermeasures available against the potential consequences of a particular risk. Starting from the quantification of the likelihood of a hazard, the study analyzes the system, and identify, using a quantitative approach, the mitigation measures against the hazard under study. The countermeasures or "*Protective Layers*", must be independent to be effective.

Procedure:

1. An important part of this process is to gather the proper cross selection of individuals so you have knowledge in the following areas of expertise;
 - a. Operational experience
 - b. Maintenance requirements
 - c. Design/equipment layout

- d. Applicable health & safety regulations
- e. Site permit requirements
- f. Familiarity with the site ERP – Emergency Response Plan
- g. History of operational upsets
- h. Equipment operation

NOTE: You do not need an individual for each item listed but it is suggested to have a minimum of 3 people for this exercise.

2. Start by selecting the area you want to review. Be sure to pick an area that is not overwhelming for the group as the larger the area, the longer it will take to complete the exercise.
 - a. If you do not have a process flow diagram, this is a good opportunity to develop one
3. For each focus area, identify the following;
 - a. Inputs – what goes into the equipment – material, energy
 - b. Outputs – what comes out of the equipment – material, energy, emissions, heat
 - c. Operational controls
 - d. Suppression systems
 - e. Maintenance requirements
 - f. Location in facility
 - g. Contents of equipment
 - h. Physical components that create heat – bearings, process, material
 - i. External components that create heat – adjacent equipment, hot work, solar, mobile equipment, chemicals
 - j. Entry points – how do materials enter, including ignition sources, air vents, conveyance chutes
 - k. Exit points – how many are there, how big, can an ignition source enter any exit point, etc
 - l. Pressure of equipment – if any? – positive or negative?
 - m. Can the contents ignite? If yes; calculate the following to be used for explosion reduction techniques;
 - i. P_{max} – maximum pressure developed by an explosion
 - ii. K_{st} – Pressure rate of rise (wood dust)
 1. 100 – 150 bar*m/s: taken from the 2012 DEKRA report completed by David Kaelin Sr
 2. 224 bar*m/s: posted on the Fauske & Associates website by AnnMarie Fauske
 3. Your particular wood dust at your site may have to be independently tested to determine this value
 - iii. MEC – minimum explosive concentration (40-60 g/m³)
 - iv. MIE – minimum ignition temperature
 - v. P_{red} – maximum internal pressure of a vented explosion
 - vi. P_{stat} – static activation pressure, vent opening pressure

- n. Proximity of equipment to sources of heat/spark/flame
 - o. Traffic route through site – will the equipment have access to mobile equipment
 - p. Hot work zones
 - q. Options for emptying the equipment of material – can the equipment be emptied easily? Or at all?
 - r. Available site resources
 - i. Mobile equipment
 - ii. Fire protection equipment
 - iii. Manning
 - iv. Emergency response personnel – on site vs local fire department
 - s. Training qualifications of site employees
 - i. Fire response training
 - ii. Incident command requirements
 - iii. SCBA needs
 - iv. First aid requirements
 - v. Mobile equipment
 - t. Contractors/suppliers available to site
 - i. Contact list – day/night/after hour contact numbers
 - u. Ability to localize the exothermic event to one section of the process
 - i. How wide-spread can the event be?
 - ii. How large can an event be?
 - v. Emergency response time
 - i. On-site responders vs off-site responders
 - ii. Emergency response capabilities
4. Once all of this information has been identified, the group will then need to look at the possible issues that can or has arisen from the equipment in question. Consider all types of scenarios when conducting this review such as;
- a. Normal operation
 - b. Day-shift vs night-shift vs weekend-shift
 - c. Regular operator vs relief operator
 - d. Scheduled maintenance day
 - e. Previous issues with equipment
 - f. Process upset
 - i. Controlled shut-down
 - ii. Emergency shut-down

- g. Weather conditions
 - i. Spring/summer/winter/fall
 - ii. Rain/snow/lightning
 - iii. Ice build-up
 - h. Expansion – process construction
 - i. ERP condition
 - i. Medical emergency
 - ii. Fire
 - iii. Flood
 - iv. External threat – bomb, sabotage, vandalism, violence
 - j. Collective Bargaining Agreement – CBA concerns
 - k. Staff vacancies – holidays/permanent/change-over
 - l. Loss of utilities
 - i. Power, gas, phone, internet
 - m. Atmospheric conditions – localized
 - i. Oxygen concentration, carbon dioxide levels, LEL, etc
5. Once the list of conditions is established, each item will need to be rated for risk using your risk matrix. It is best to determine risk without the use of controls, IE. If the risk is exposure to energized equipment, consider that you don't have a lockout-tagout procedure in place. The group will then need to review the identified risks with their associated risk value. Focus attention on the highest risk rated items and one by one list all of the controls that the site has fully in place in order to mitigate the consequences. Once your control measures are listed, re-rank the risk considering the controls in place, this will give a more accurate risk rank.
6. Review the list again to identify the highest ranked risks with controls in place. The group will need to then decide if there are enough controls in place to bring the level of risk to an acceptable level. If the risk is still too high, additional controls will need to be considered in order to satisfy your level of acceptable risk.
7. For each risk that is above the acceptable level, a procedure needs to be developed as a response plan for this type of event.
- a. Add this to your existing ERP if not already present
 - b. Communicate this risk to all site personnel
 - c. Give appropriate training as required to site employees
 - d. Practice mock scenarios to gain familiarity with the procedure