**What-if Analysis Risk**

**Definition:** A technique using brainstorming to determine what can go wrong in specific scenarios and identify the resulting consequences.

**Overview**

What will happen if toxic gases leak into a liquid pipeline? What if tank feed is increased or decreased? What if an earthquake occurs? Such questions can be critical in reducing or eliminating risks to people working in a laboratory environment.

A What-if Analysis consists of structured brainstorming to determine what can go wrong in a given scenario; then judge the likelihood and consequences that things will go wrong.

**How to Conduct a What-if Analysis**

1. **Team Kickoff:** The team leader walks the team through each step of the What-if Analysis. The leader may use a detailed equipment diagram along with any prepared operating guidelines. (Include guidelines for determining acceptable level of safety.)

2. **Generate What-if Questions:** The team generates What-if questions relating to each step of the experimental procedure and each component to determine likely sources of errors and failures.

3. **Evaluate and Assess Risk:** The team considers the list of What-if questions, one-by-one, to determine likely sources of errors. They then decide the probability of each error occurring and assess the consequences.

4. **Develop Recommendations**

**Risk deemed unacceptable:** If the team concludes there’s a need for corrective action, a recommendation is recorded.

When probability is very low, consequences are not severe, and the action to correct the condition would involve significant cost and time, the team may note a “no recommendation” response.

5. **Prioritize and Summarize Analysis:** The team’s analysis is summarized and prioritized.

6. **Assign Follow-up Action:** Responsibilities are assigned for follow-up action(s). Consider adding a column to your What-if Analysis form to indicate the person or group responsible for each corrective action.

**Sample What-if Questions**

Following is a list of sample What-if questions to get your group thinking in the right directions. These questions can be modified according to experiment or process.

**Human Factor**

Human errors occur regardless of training and experience. Human error factors may drive consideration of written SOPs, a decision for engineering controls, etc.

What if material used is too concentrated (or diluted)?

What if the valve/stopcock does not open (or close)?

What if the valve(s) are opened (or closed) in the wrong sequence?

What if inert gas is omitted?

What if unintended materials are mixed together?

What if readings are missed or ignored?

What if warnings are missed or ignored?

What if there are errors in diagnosis?

**Utility**

The following questions concern utilities, which are key to the support of any experiment or process:

What if power is lost?

Consider: Automatic shutoffs and emergency power

What if power is restored automatically after loss?

Consider: Manual restarts

What if laboratory ventilation is lost?

Consider: Automatic shutoffs, emergency power, and redundant mechanical exhaust fans

Experimental or Ancillary Equipment

Consideration of failure of materials or components may result in decisions for additional controls or changes to higher rated or alternative types of materials and components.

What if there’s unexpected over-pressurization?

Consider: Pressure relief devices and barriers; personal protective equipment (PPE)

What if glassware breaks during reaction?

Consider: Spill control; PPE

What if there’s a failure of equipment cooling?

Consider: Alarms, automatic shutoffs, and emergency shut-off procedures

**Personal Protection**

This should be included since, despite best efforts with hazard reviews and training, incidents will occur.

What if a body is impacted by liquids or solids?

Consider: Physical barriers

What if someone is exposed to vapors or gases?

Consider: PPE; ventilation

What if someone is exposed to respirable particles?

Consider: Use of wet contamination control methods, ventilation controls, and respiratory protection