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HAZOP REVIEWS

by
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Recently Gossman Consulting, Inc. had the opportunity to perform a HAZOP (hazard and operability) review for a facility in Europe. While such a review is common for industrial facilities in Europe, it is only commonly performed in the United States at chemical facilities usually as a requirement of the OSHA Process Safety Management regulations (29 CFR 1910.119). A more common practice in the United States is a facility audit which looks at a variety of health, safety and regulatory issues and may loosely prioritize a series of recommended improvements as a result. The more formal HAZOP review uses a list of keywords to examine each part and operation of a facility to determine both the probability and consequence of each mode of failure. Based on this combination of probability and consequence, the risk is determined. Any unacceptable risk requires a high priority corrective action.

The first step in a HAZOP is to break the facility down into subsections, either lines or individual pieces of equipment such as a tank, pump, agitator, etc. The degree to which this first step is done often determines how rigorous the HAZOP will be. HAZOPs are often done to different levels of rigor. We performed, and I will be describing, a medium level HAZOP; although different companies have established company/ industry specific definitions and procedural issues for such levels.

Figure 1 provides a form that can then be used to evaluate a specific line or piece of equipment. Table 1 provides a list of guide words and deviations that are used to evaluate each piece of equipment/line. Given a *guide word* and *deviation* produced by a theoretical *cause* the *consequences* must then be determined. Each *consequence* is evaluated against frequency and severity. Finally, after each *consequence* is evaluated, a form similar to Figure 2 is completed to determine corrective actions for each unacceptable *consequence*.

A HAZOP review can be performed based on drawings prior to construction, just prior to startup or periodically during operation of a facility. The review can identify significant flaws in facility design and operations and thereby reduce the risks to human health and safety and the environment.



HAZARDOUS AND OPERABILITY STUDY WORKSHEET

Site:

Plant:

Line/Equipment

Guide Word	Deviation	Cause	Consequence	Action

Figure 1

Table 1

<u>Guide Word</u>			<u>Deviation</u>
	Flow		More No Less Reverse Other Also
	Pressure		More Less
	Temp		More Less
	Viscosity		More Less
	Relief		Other
	Samples		Other
	Instruments		Other
	Corrosion		More
	Erosion		More
	Services		Other
	Maintenance		Other
	Static		Other



Table 2

PRIORITIZATION OF SAFETY, HEALTH AND ENVIRONMENT ISSUES

ASSESSMENT KEY

CONSEQUENCE CATEGORY	PROPOSAL FOR EXPENDITURE - SAFETY, HEALTH OR ENVIRONMENT IMPROVEMENT								
CATEGORY 5 EXTREMELY SERIOUS CONSEQUENCE	TOLERABLE BAND								
CATEGORY 4 MAJOR CONSEQUENCES			TOLERABLE BAND				UNACCEPTABLE		
CATEGORY 3 SEVERE CONSEQUENCES					TOLERABLE BAND				
CATEGORY 2 SERIOUS CONSEQUENCES			TOLERABLE				TOLERABLE BAND		
CATEGORY 1 SIGNIFICANT CONSEQUENCES									TOLERABLE BAND
EVENT FREQUENCY PER YEAR	10-7	10-6	10-5	10-4	10-3	10-2	0.1	1	10
	EXTREMELY UNLIKELY		VERY UNLIKELY		UNLIKELY		POSSIBLE		PROBABLE
FREQUENCY CATEGORY	1		2		3		4		5
Example	Consequence Category 3 and Frequency Category 4						3-4		

PRIORITIZATION OF SAFETY, HEALTH AND ENVIRONMENT ISSUES

GUIDANCE FOR CONSEQUENCES CATEGORIES

	CATEGORY 1 EVENT SIGNIFICANT CONSEQUENCES	CATEGORY 2 EVENT SERIOUS CONSEQUENCES	CATEGORY 3 EVENT SEVERE CONSEQUENCES	CATEGORY 4 EVENT MAJOR CONSEQUENCES	CATEGORY 5 EVENT SERIOUS CONSEQUENCES
TYPICAL MEDIA ATTENTION	Noted in Local Press, TV & Radio Few telephone calls	Significant local attention, interviews Adverse local comment	Considerable local, some national attention Local outcry	Headline national, continuing local attention	International news, outcry threatens to close operation
TYPICAL ACTION BY AUTHORITIES	Notifiable	Warning	Prosecution	Severe Fine	Prohibition
ACUTE INJURY INCIDENT - on-site effects	Minor/classified injury Low probability of Lost Time Accident	Lost Time Accident Low probability of major injury	Major injury Multiple injuries Low probability of fatality	Fatalities or few employee fatalities Low probability of many fatalities	Many fatalities (ie 5 or more)
ACUTE INJURY ACCIDENT - off-site effects	Nuisance off-site- see Environmental	People affected- short term minor	Few people require hospital treatment	Serious injuries 10s in hospital	Fatality or fatalities off site; many injuries
CHRONIC HEALTH OR PHYSICAL CONDITION - on- site effects	Occasional releases above Occupational Limits - OEL or STEL - low hazard materials Unpleasant conditions	Persistent releases above limits - 2 to 6 times Occupational Limits - non-carcinogen Harmful conditions	Distressing <i>exposure</i> Significant health effects Harmful, irreversible, unacceptable effects Sensitization effects	Employee <i>exposure</i> to high levels of carcinogens, e.g. asbestos, benzene, vinyl chloride, or life- threatening conditions	Many cases of ill health and resultant fatalities Health risk unacceptable due to continuous or discrete large releases



HAZARD AND OPERABILITY STUDY ACTION SHEET

DATA FILE:

ACTION ON:	RESPOND BY:
ACTION NO:	MEETING DATES:
DOCUMENT REFERENCE:	REVISION:
TITLE:	
ITEM:	
CAUSE:	
CONSEQUENCE:	
SAFEGUARDS/COMMENTS:	
ACTION:	
RESPONSE: DATED:	
SIGNED:	

Figure 2