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## Process Safety Management of Highly Hazardous Chemicals – Part 3

By Jerry Lacatena

This brief article is a continuation of prior articles on Process Safety Management (PSM) to provide information on requirements to minimize unexpected or accidental releases of toxic, reactive, and hazardous chemicals listed in the OSHA PSM Standard (1910.11), and to prevent potential disasters from occurring. Information was largely obtained from the source documentation. This brief article focuses on process hazard analysis (PHA) and operating procedures pertinent to PSM.

### Process Hazard Analysis

The PHA is a thorough, systematic approach for identifying, evaluating, and controlling the hazards of processes involving highly hazardous chemicals. The company needs to perform an initial hazard evaluation on all processes covered by this standard. The PHA methodology selected must be appropriate to the complexity of the process and must identify, evaluate, and control the hazards involved in the process.

Companies should first determine/document the priority order for conducting PHA based on a rationale that includes such considerations as the extent of the process hazards, the number of potentially affected employees, the age of the process, and the operating history of the process. All PHAs must be updated and revalidated based on their completion date, at least every five years.

A number of PHA methods are available that companies may use as appropriate to determine and evaluate the hazards of the process being analyzed. These methods include:

- What-if
- Checklist
- What-If/Checklist
- Hazard and operability study (HAZOP)
- Failure mode and effects analysis (FMEA)
- Fault tree analysis
- An appropriate equivalent methodology

### Work Highlights

#### Machinery

- Performed a root cause failure analysis of seal design and installation for a hot crude oil pump after multiple failures had occurred, one leading to a fire that caused a unit shutdown. The analysis revealed fundamental problems with bearing design that led to seal failures, and issues related to the seal itself. Recommendations were made to improve the situation, which also apply to other hot pumps at the refinery.

#### Process

- A client is considering replacement of the FCCU regenerator air grid due to mechanical reliability issues. Carmagen conducted a FCCU process engineering "cold eyes" review of the grid design options under consideration and their associated process and mechanical issues. Assistance was provided in selecting the appropriate grid replacement option.

#### Safety

- Participated and integrated within client's safety and noise NPOC team that will extend for a few years. The overall mega-project involves a major "clean fuels" revamp of a Middle East refinery and competitive proprietary technology, which cannot be exposed to client's staff.

Whichever method(s) are used, the PHA must address the following:

- Hazards of the process
- Identification of any previous incident that had a potential for catastrophic consequences in the workplace
- Consequences of failure of engineering/administrative controls
- Facility siting
- Human factors
- Qualitative evaluation of a range of the possible safety/health effects on the workforce if there is a failure of controls

OSHA believes that the PHA is best performed by a team with expertise in engineering and process operations, and that the team should include at least one employee who has experience with and knowledge of the process being evaluated. Also, one member of the team should be knowledgeable in the specific analysis methods being used. The company must establish a system to address the team's findings/recommendations; ensure that the recommendations are resolved in a timely manner; and documented, maintained, and communicated to employees whose work assignments may be affected by the PHA recommendations or actions.

### **Operating Procedures**

Written operating procedures must be established, consistent with the process safety information and equipment installed, and communicated to employees.

The procedures need to address at least the following elements:

- Steps for each operating phase, such as startup, normal and temporary operations, emergencies, and shutdown scenarios.
- Operating limits, such as consequences of deviation; steps to correct/avoid deviation; safety considerations; properties of, and hazards presented by, the chemicals used in the process; inventory levels; precautions to prevent exposure; control measures if exposed; safety systems; etc.

It is vital that operating procedures be readily accessible to employees who work in, operate or maintain a process, and ensure that they reflect current operating practices, including changes in process chemicals, technology, and equipment. An annual review is needed to verify that operating procedures are accurate and appropriate.

*Carmagen Engineering, Inc. is an engineering consulting company with experienced staff that can support clients' efforts associated with the various process safety management activities necessary for safe operation and compliance of their facilities.*

### **About the Author**

*Jerry Lacatena has over 35 years of process engineering experience in a broad range of design applications and technologies. He is a proficient and organized multi-tasker, having extensive plant design experience on numerous revamp and grassroots projects throughout the world, with projects ranging from feasibility studies, technology evaluation, FEED, EPC development, to plant performance testing. Jerry has excellent presentation, communication, coordination, and interpersonal skills utilized to develop strong working relationships with team members, clients, vendors, sub-contractors, and technical licensors.*

*Please contact Jerry Lacatena, Process Department Manager (jlacatena@carmagen.com), if you'd like more information on Carmagen's expertise in this area. Carmagen Engineering, Inc. is an engineering consulting company with experienced staff that can support clients' efforts associated with the various PSM activities necessary for safe operation and compliance of their facilities.*

