



## Process safety data management program based on HAZOP analysis and its application to an ethylene oxide/ethylene glycol plant



Feng Wang<sup>a,\*</sup>, Yankun Zhao<sup>a</sup>, Ou Yang<sup>a</sup>, Jingbo Cai<sup>b</sup>, Mei Deng<sup>b</sup>

<sup>a</sup> National Foundation Research Laboratory of Fault Prevention and Hazardous Chemicals Production System, Beijing University of Chemical Technology, Beijing 100029, China

<sup>b</sup> China Petroleum Technology & Development Corporation, Beijing 100028, China

### ARTICLE INFO

#### Article history:

Received 12 June 2013

Received in revised form

30 August 2013

Accepted 30 August 2013

#### Keywords:

Abnormal situation

Process safety data management

HAZOP

Reaction temperature

### ABSTRACT

HAZOP analysis is a process hazard analysis method that has been widely applied both within and outside the chemical processing industries. This paper presents a design method for a process safety data management program for petrochemical plants based on HAZOP analysis and demonstrates the steps of application involved in building a process safety data management system for an ethylene oxide/ethylene glycol production plant. Firstly, the production data files and relevant documents of the plants should be classified and stored in the program database as reference documents and treatment schemes for coping with abnormal situations should be collected and summarized as guidance documents. Secondly, the HAZOP analysis method is employed to identify all the dangerous deviations possibly existing in the production process of the ethylene oxide/ethylene glycol plant. Then, the relationships among the deviations, the reference documents and the guidance documents should be considered and evaluated. Finally, each dangerous deviation will be given a corresponding reference document and guidance document. The reference documents and guidance documents stored in the expert system can be utilized to help operators solve the corresponding technical problems and cope with abnormal situations. The process safety data management program will contribute to the identification, analysis and resolution of operation problems. When an abnormal situation occurs, according to the deviations exhibited in the system, the necessary reference documents and guidance documents will be quickly consulted by the operators, and an appropriate decision will be made to address the abnormal situation. Therefore, by using the process safety data management program, plant security and human safety in the petrochemical industries will be improved.

© 2013 Elsevier Ltd. All rights reserved.

### 1. Introduction

The considerable reduction in energy reserves and the substantial increase in crude oil prices have caused the majority of petrochemical managers to attach more importance to production optimization and efficiency improvement than ever before. The increasing automaticity in the industry has led to more equipment working in extreme operating conditions, such as in environments with high temperature or high pressure. Unfortunately, some operators have poor access to abnormal situation management experience due to the drastic decline in the number of employees and their average age. Furthermore, there are many risk factors, such as misoperation, equipment failure, instrument error-

indicating, and environment-polluting, with complex relationships among them (Wang, Gao, & Guo, 2009). For all of the above reasons, equipment is often operated under abnormal situations, and the annual occurrence rate of accidents has continuously increased. Accidents cause serious casualties, environmental pollution and financial loss. Therefore, enterprises need to adopt effective measures to strengthen the process safety management of the production processes, enhance the safety consciousness of the industries, and improve the operation abilities and enrich the experience of individual operators. When abnormal deviations occur, it is important for the operators to understand the relationships among all the risk factors, identify the causes that have resulted in the abnormal situations, forecast the adverse consequences, and consider all available measures to cope with the situation.

Ethylene oxide is an organic chemical that is essential to the production of ethylene glycol, and ethylene oxide/ethylene glycol

\* Corresponding author.

E-mail address: [wangfeng991@163.com](mailto:wangfeng991@163.com) (F. Wang).

plants are one of the most profitable plants in the oil-refining enterprises. Unfortunately, temperature runaway accidents, causing plant shutdown, frequently occurs in the ethylene epoxidation reaction and results in the catalyst and the reactor being burned and losing their effectiveness. A serious explosion accident can occur if operators do not take effective emergency measures in time (Raghaven, 1992).

Currently, production enterprises have recognized the seriousness of temperature runaway accidents, and many research institutions and researchers investigated processes to control temperature runaway, including model construction, risk identification, safety assessment, accident prediction, emergency response, safe operation, and environmental protection (Bosch, Strozzi, Snee, Hare, & Zaldívar, 2004; Chen, Wu, Wang, & Shu, 2008). However, there are still many details that should be taken into account to ensure the safe and stable operation of the equipment.

- (1) The reference materials required to handle abnormal situations are the process design package, operation procedures, quality record, production record, maintenance instructions and ministry specifications, as well as the operators' processing experience. However, in some industries, design data generally differ from the real production data. The reason is that changes in the raw material, production load, production process parameters and any other factors require alteration of the operation values of some process parameters. Sometimes the process parameter values recorded in the reference materials have not been updated.
- (2) Operators and control systems have recorded mass data and generated numerous text documents. It is difficult for the operators to obtain the necessary data or the reference documents when an abnormal situation occurs. The process

of searching, learning, researching and analyzing numerous text documents is time-consuming for operators. Hence, it may sometimes make the operators miss the best chance to identify the causes of the abnormal situations and make the correct decisions to handle the problems.

- (3) Risk identification and safety assessment are performed in almost all petrochemical industries. The chemical industries are strictly required to conduct HAZOP analysis every five years. Although the industries have spent significant amount of labor force, time, and money on HAZOP analysis, they do not make effective use of the analysis results. One possible reason may be the huge amount of money required to implement the suggestions and adopt the recommended measures according to the HAZOP results, especially when the safety are not immediate and obvious. Consequently, HAZOP analysis reports are merely archived, and HAZOP analysis has been reduced to a superficial form of process safety management.

If a program stores all available methods and measures for the abnormal situations and offers several available decisions according to the analysis of their advantages and disadvantages and the reference data, it is immensely helpful for the operators to make choices to tackle the problems properly according to the procedures provided by this program. Hence, it is necessary to ensure effective management of the data that can be referenced to keep the process safe, which will contribute to the process safety management. This paper will concentrate on both the approach of the process safety data management and the program and applications for chemical production plants. To standardize the process safety data management, reduce operational error, accumulate and share processing experience knowledge and to use the HAZOP analysis result, a process safety data management program should be developed.

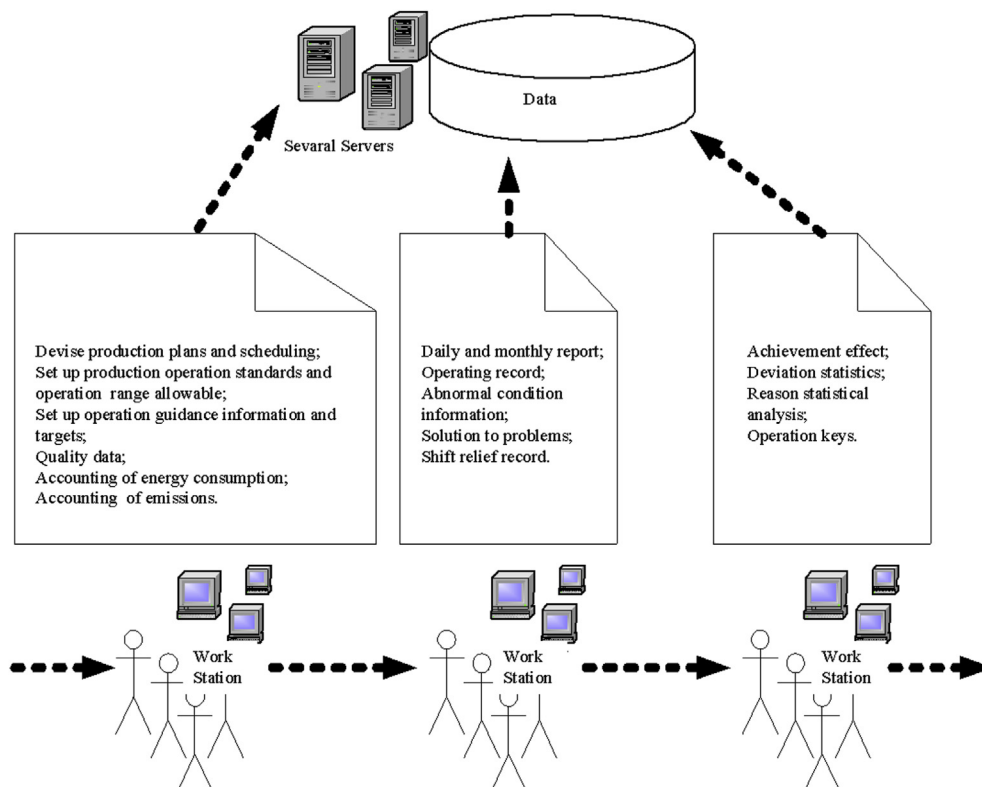


Fig. 1. Sketch of the daily production environment.

Download English Version:

<https://daneshyari.com/en/article/586423>

Download Persian Version:

<https://daneshyari.com/article/586423>

[Daneshyari.com](https://daneshyari.com)