



Korean experience of process safety management (PSM) regulation for chemical industry



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ABSTRACT

From the 1960s, Korean industries have been encouraged by the government to nurture heavy and chemical industry and to modernize the economics and industrial structures. The development of chemical industry particularly became the turning point in industrial development, and played a major role in the construction of a new industrialized country. However, the process systems in the chemical industry have become more complex and larger, and the inventories of dangerous chemicals that are produced or consumed have continuously increased. Therefore, the hazards from potential accidents such as fire and explosion or release of toxic chemicals have also increased. In fact, from the end of 1980s to the beginning of 1990s in Korea, a number of major industrial accidents such as ABS extruder explosion, TDI release and dryer explosion, etc. Occurred and caused many fatalities. As the chemical companies recognized the importance of preventing major hazards, PSM system, the prevention of major industrial accidents, was introduced in January 1995 by amending Industrial Safety and Health Act, and it has been enforced from January 1, 1996. According to the law, the business owner of a workplace with hazardous or dangerous equipment shall submit a process safety report to the Government to prevent any accidents, which could inflict an immediate damage on workers or on areas in the vicinity of the workplaces. As a result of PSM implementation for 19 years, chemical accident prevention system has been stabilized and various kinds of effectiveness and desirable customer satisfaction have been made.

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1. Background for legislation of PSM system in Korea

In case of the toxic chemical release, fire, or explosion, there are major catastrophic consequences not only to employees but also to residents as well as environment. In addition, financial losses caused by the damage of the facility are enormous, and it takes long time to repair the facility; these bring other impacts such as insufficient supplies of raw materials to the related industries.

To prevent such major industrial accidents many countries including USA and EU have been implementing chemical accident prevention system.

In July, OSHA in USA announced the plan to declare the federal regulation; this became the starting point of establishing the special law to prevent major industrial accidents in USA, and PSM regulation was enacted in November, 1992 (CCPS and AIChE, 1989).

In 1982, European Union adopted EC Directives (Seveso Directives) which was similar structure to PSM system in USA. EC Directives presented minimal legal standards for every country in European Community to observe; the objectives of this directive were to prevent major industrial accidents and mitigate the damage to people and environment. Member countries of EU have to apply more severe standards than this directive in their own legislation.

A dire need for national plan of chemical accident prevention arose after the MIC release resulted in fatalities of 2500 in Bhopal, India in December 1984 (ILO, 2001), and ILO announced the declaration in 1985 that there should be a systematic procedure for preventing major industrial accidents. Prevention of major industrial accidents was enacted as the 174th Convention in June, 1993 (KOSHA, 2001).

In terms of preventing many numbers of major accidents occurred in Korea from the end of 1980s to the beginning of 1990s, new safety management system like PSM became necessary in chemical plants.

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2. The PSM related law

As the chemical companies recognize the importance of preventing major hazards, PSM system for the prevention of major industrial accidents was introduced in January 1995 by amending Industrial Safety and Health Act, and it has been enforced from January 1, 1996.

The major contents of Industrial Safety and Health Law concerning PSM system are as follows.

- (1) An employer of hazardous installations shall submit the process safety report to Ministry of Labor/KOSHA under the Presidential Decree for preventing major industrial accidents such as fire, explosion and release of toxic chemicals which can cause a serious danger to employees, residents in the nearby community.
- (2) The process safety report prepared by employer shall be reviewed by the Safety and Health Committee in the workplace before submission. If the committee was not established, the report shall be reviewed by the representative of employees
- (3) The Ministry of Labor/KOSHA shall assess the process safety report and can order the employer to change the report in case it is necessary for the safety and health of employees
- (4) An employer and employees shall take necessary measures in compliance with the process safety report.
- (5) Implementation of PSM by employer in compliance of process report shall be confirmed by Ministry of labor within 2 years after plant operation. PSM performance of each company is classified into three grades (P, S and M), and intervention to the PSM sites is applied differently by the performance grade. Grading the sites by their PSM performance is a unique approach in Korea, not in EU nor USA, and good effectiveness has been made.

Hazardous installations prescribed in the Law shall be business categories or installations handling and storing hazardous materials more than threshold quantities as listed in Table 1. In the beginning, the number of hazardous materials was 21, but the number was increased to 51 last year. This amendment was made to be intended to confirm whether the current PSM coverage is reasonable or not, through the in-depth study of relevant foreign legislations, and to present how to determine the PSM scope more reasonably.

In order to accomplish the aim, we compared the PSM legislations and coverage of USA, EU and UK with each other; analyzed the survey of the amounts of current industrial chemicals in Korea; compared the classification of categorized hazardous chemicals in PSM regulation with GHS(Globally harmonized system of classification and labeling of chemicals); and evaluated the cost-benefit effect of the draft suggested in this study. As COMAH regulation of UK is well developed under basic requirement of EU SEVESO Directive, it became good reference for us. We also referred to the internal and external sundry documents, interviewed the interested persons in USA, UK and EU, referred to domestic investigation reports of major-accident, and consulted with experts on this concern.

- Refineries.
- Re-processing of by-products of petroleum refining.
- Petrochemical organic chemicals or synthetic resins.
- Fertilizers industries.
- Pesticide/herbicide.
- Explosive powder/fireworks products.

Nuclear power plants and military facilities are excluded from the PSM regulation as they are controlled by the separate laws.

The following contents shall be included in the process safety report prescribed in the law.

- (1) Process safety information
- (2) Hazard analysis and risk assessment report
- (3) Procedure and planning for safe operations for installations
 - Procedure and manual for safe operation.
 - Procedure and specification for mechanical Integrity.
 - Procedure for hot work permit.
 - Safety control procedure for contractor's work.
 - Education and training plan.
 - Procedure for management of change.
 - Procedure for pre-startup.
 - Audit procedure.
 - Procedure for incident investigation.
 - Others related to safety management.
- (4) Emergency planning and response

3. Implementation of PSM

In March 1995, KOSHA established the Center for Chemical Plants Safety consisting of professional engineers to implement PSM system for the prevention of major industrial accidents. There are 1,684 PSM sites which are controlled by PSM regulation recently.

The PSM companies are categorized in accordance with their business category and number of employees as shown in Table 2. Among 1,684 companies, 123 belong to the business categories and the other 1,561 belong to the hazardous installations handling or storing hazardous materials. And there are 704 small and medium sized plants in which the number of employees is below 50.

Meanwhile, in order to evaluate the status of PSM performance in chemical companies, 1,064 sites was checked by using 105 items of check list and graded into three groups as shown in Table 3.

One hundred one companies, which form about 9.5 percent ranked P level that means PROGRESSIVE, while 394 companies, which form about 37.0 percent received S level that means STAGNANT. And 569 companies with poor and unreliable condition in safety management, which form 53.5 percent, ranked M level that means MISMANAGEMENT. According to our analysis, portion of P level in large companies is relatively higher than that in small companies, and portion of M level in small companies is relatively higher than that in large companies. Based on the result of grading, performance based inspection criterion is applied to the PSM sites as follows; – P (Progressive): self implementation of PSM.

– S (Stagnant): check of implementation of PSM more than once per year by the concerned authorities.

– M (Mismanagement): check of implementation of PSM, more than twice per year by the concerned authorities. Technical advice for the checked item and PSM training every 6 months.

PSM performance of each company is re-evaluated every 4 years, and new grade is given. PSM grading system brings the benefits including facilitating workplaces' participation, encouraging competition among PSM sites, making easy to monitor the compliance of PSM regulation, helping policy makers to monitor exact status of PSM implementation in the workplaces and eventually proving the direction of the improvement of PSM regulation.

4. Effectiveness and customer satisfaction

As a result of PSM implementation for 19 years, various kinds of effectiveness were made. The number of major industrial accident including the number of fatalities has been decreased after PSM

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