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Improved Process Safety Management and Simple Metrics

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ABSTRACT

A Process Safety Management (PSM) system was implemented at Gulf Coast Waste Disposal Authority (GCWDA) to enable management of the increased risks brought about by the introduction of large quantities of oxygen in the processing of chemical waste and the destruction of emissions through Regenerative Thermal Oxidizers. This was a voluntary effort by GCWDA since they do not fall under the OSHA PSM Standard (29 CFR 1910.119). A tailored system was developed that could comply with the OSHA Standard if necessary, but included additional elements that improved on it and that are practiced by the U.S. leading chemical companies.

These elements include Management Commitment, Management Review, Conduct of Operations and Continuous Improvement. In order to allow for continuous and proactive management review simple metrics were created for each of the PSM elements rather than depending upon a periodic audit or the common use of incident statistics.

This paper will deal with the implementation of the PSM system from both the perspectives of the consultant that helped in the implementation and the facility management that had to adopt it. The successes and some of the barriers for implementation in a small company will also be discussed as well as the management success in the year after its implementation.

Introduction

When Gulf Coast Waste Disposal Authority (GCWDA) decided to increase their level of process safety due to increased risks, the challenge was how to devise a system that could be managed and sustained by a small company with limited resources. GCWDA was ready to bring in large quantities of oxygen into their Bayport plant in order to increase the treatment efficiency, and thus the capacity, of its waste digestion tanks. In addition, these large atmospheric aeration tanks (110 ft in diameter) were going to be covered and their off-gas sent to newly installed regenerative thermal oxidizers in order to significantly reduce emissions from their operation. These changes would introduce significant higher risks to the plant than what had been common. Because GCWDA provides chemical waste disposal services to more than sixty petrochemical facilities located in the Bayport industrial park southeast of Houston, Texas, its safe continuous operation is critical to the smooth and environmentally-compliant operation of the petrochemical industry in the area. Thus, implementation of a process safety system that would help ensure uninterrupted operation became a necessity.

Need for a PSM System

Although GCWDA had safely operated its Bayport facility for many years, the number of customers had been steadily increasing and the nature of the incoming wastes was changing and its variability was becoming more pronounced. This required increased monitoring and added instrumentation, but it was being handled as the plant had little turnover and the operating personnel had become very experienced. This had led to a dearth of written standard operating procedures (SOPs) in both the operations and maintenance areas. Because of the low organic concentration of the incoming waste, the operation was perceived as low risk and the emphasis had been on occupational safety rather than process safety. Flammability issues were limited to the main lift (pumping) station which had been mitigated by increasing communication with all the waste discharging facilities to avoid similar incidents.

With the proposed expansion of the facility and the introduction of oxygen and new more complex equipment, a need for a more structured operating environment was recognized. A Process Hazards Analysis (PHA) of the project was conducted with the help of personnel from the client industries and this PHA unveiled potentially significant risks. It became evident to GCWDA that an improved process safety system would be needed and KnowledgeOne was engaged to help in this endeavor.

Deciding on a PSM System

Because GCWDA was not subject to OSHA's Process Safety Standard (29 CFR 1910.119) given the very limited quantity of organics in the plant and their great dilution, a tailored system could be devised. The system would have to be suitable for a small facility, capable of being monitored with minimal resources, and of course, most

important, able to ensure a high level of safety. A framework similar to OHSAS 18001¹ was adopted since it includes important elements such as management commitment, management review, and a continuous improvement cycle and documentation control, which OSHA 1910.119 does not offer. All the elements of OSHA 1910.119 were included, because they do provide a structure for maintaining a safe operating environment. The elements were not copied exactly as written in 1910.119 but tailored for the company and the facility. With a little tweaking this management system would be totally compliant with the OSHA Process Safety Standard. In addition, other elements that are practiced in leading petrochemical companies, such as Conduct of Operations (sometimes called Operational Discipline) were included. As opposed to OSHA's, which is a performance-based standard, this system was designed with specific requirements of well defined scope.

Design and Implementation of the PSM System

A team was formed in order to review in depth the policies of procedures as were being developed. To assure that a workable system would be developed and buy in from top management would be obtained, the team included the Manager of Operations, Facility Manager, the authority's Technical Director, Director of projects, Operations Supervisor, and the plant's Compliance Coordinator. As needed, the Maintenance Supervisor was called in for the meetings. During the development of the system a full time Safety/Process Safety professional was hired and he became an integral part of the team. The first decision of the team was that approval of any policy was to come from the authority's General Manager.

As each policy was developed and reviewed, all personnel were trained on the content of the policy, and those affected on all the new aspects of their work as required by the policy. During the process a risk matrix was developed for the company, with the participation of the top management of the company.

The first policy that was develop was an overall policy named Facility Safety and Health Policy that described the framework, set the management expectations, described the elements that would be considered and established overall metrics. All policies developed under this policy would have, besides its requirements, an objective, a scope, a periodic review of the policy and a person responsible for that review. The main component of this master policy was a continuous improvement cycle, where management commitment and goals were set, a plan was made, the plan executed, the results were assessed, and corrective action would be taken if the results did not match the plan. The cycle would then begin again with new goals with inherent improvement in those goals.

The other important component of the master policy was dictating periodic management review of the process safety management system. In order to facilitate this review, besides the overall metrics, each procedure was to have measurable actions or results that could either be tracked or compared to a standard. The intent was not to rely solely on an audit that would be conducted every few years or on lagging indicators such as incidents.

The overall metrics that were set are:

¹ OHSAS 18001 is an international occupational health and safety management system specification in the same vein as ISO 9001 and ISO 14001.

- Number and trend of incidents and near misses per hours worked (monthly).
- Number and trend of open, temporary, and past due changes under Management of Change (MOCs), (monthly).
- Percent of employees attending required safety meetings or training (monthly).
- Number of client slugs and spills incidents requiring formal enforcement^{2,3}.
- Number of LEL (Lower Explosive Limit) required control actions on First Step tanks.

Although the last metric could have been included in the first one, it was separated to indicate its importance to the facility.

The second policy that was developed was a Data and Document Control policy, which was formalizing the existing record keeping, necessary as part of the environmental compliance required by the Environmental Protection Agency (EPA) and Texas Commission on Environmental Quality (TCEQ). The Safety and Health (S&H) documents were included in this controlled record keeping and the opportunity was used to move from a purely paper system to computerized document control. This turned out to be a great benefit during the development of the PSM system.

This policy was immediately followed by an S&H Documentation policy which defined which documents were to be kept and what data was to be maintained. This policy has very similar requirements to those of OSHA's Process Safety Information. The records, S&H Documentation, and the policies themselves were placed under Management of Change (MOC), which was the next policy to be developed. Description of the policies and the metrics that were set follows with emphasis on the differences with the OSHA Process Safety Standard.

Elements of the PSM System

For the most part the Safety/Process Safety Coordinator was designated to either review or initiate the periodic review of the policies, and to collect the information required by the policies and present it to the Facility Manager at the periods dictated by the policies. The S&H policies that were established are:

- **Data and Document Control.** Provides for a header in which the frequency of review of the document is stated and its retention date. Designates the Records Coordinator as responsible for control of documents.
- **Safety and Health Documentation.** Described above, provides also for maintaining a list of all S&H documents. It explicitly includes documents related to the PSM System itself such as training records, records of management reviews, records required by laws and regulations, etc.
- **Management of Change (MOC).** Similar to OSHA's MOC. Requires monthly reporting on open, temporary and past due MOCs. The system is managed with

² Slugs refer to discharges of highly concentrated organics in a short time period.

³ GCWDA as an Authority has legislative power and is required to enforce the environmental permits made with the companies (clients) that discharge waste into the facility.

the help of a database that automatically collects these metrics, has e-mail requests and notifications, and secure electronic approvals (there are no paper MOCs). Although not mandated by the policy the Facility Manager reviews all the MOCs that are written.

- **Conduct of Operations.** Establishes the structure of the operations organization and responsibilities for maintaining competent and sufficient operations personnel. It describes the format and content of Standard Operating Procedures (SOPs). It sets standards of operation which include having a list of critical SOPs to be performed as checklists, a list of equipment whose malfunction initiates immediate action to correct, maximum times to acknowledge alarms and take action on them, allowance for process shutdown on failure of critical interlocks, operator communications and expected behavior. The metrics are the monthly number of inoperable interlocks and alarms with duration of inoperability, the percent of SOPs reviewed during the quarter and the percent of operators that have had refresher training during the semester.
- **Hazards Identification and Risk Control.** This policy dictates the use of Process Hazards Analyses (PHAs) similar to what OSHA has, but adds the requirement to use a risk-based approach to hazard elimination or reduction. In addition, it identifies process areas where modifications require a PHA and specifically dictates that an operator be a member of the PHA team. It also describes other mechanisms for hazard identification besides PHAs, such as work permits, MOCs, work orders, pre-startup safety reviews, etc.
- **Pre-Startup Safety Review (PSSR).** Besides the requirements of verifying that everything has been done in accordance with specifications, that all necessary procedures are in place, that personnel has been trained, and all PHA recommendations have been resolved, the Facility Manager has to sign the PSSR, and any items that are not in compliance with the requirements have to be signed off by the Facility Manager and the Process Engineer responsible for the startup, and that a plan of completion with dates be made.
- **Mechanical Integrity.** It calls for similar requirements to those of OSHA, but it requires considering risk for deciding on the frequency of inspections. All maintenance specific procedures are developed and captured through this section. Semi-annual maintenance training statistics is reviewed in this required metric.
- **Emergency Planning and Response.** This procedure provides the most probable scenarios that can affect the facility and requires that they be addressed in the Emergency Plan. It spells out areas that need to be covered in the Emergency Plan such as Roles and Responsibilities, Emergency Communications, On-Site Personnel Safety, Emergency Plant Operation, Securing of Physical Assets and Personnel Evacuation. It also requires that the Emergency Plan contain a specific response to events such as a hurricane.
- **Contractors.** This policy spells out in detail the facility's and the Contractor's responsibilities much as OSHA does but adds detail to Contractor security and accountability inside the facility. The required metrics are the monthly number of incidents in which contractors were directly or indirectly involved, classified by contractor company, and a yearly evaluation of contractor training records.

- **Training and Competence.** Besides the OSHA requirements of being trained on the process and on the safety of job tasks, the policy requires the Facility Manager to have a competent work force that is also trained on all the aspects of the PSM System. The metrics are quarterly statistics on operator training, semi-annual statistics on maintenance training, and annual statistics on training of the workforce.
- **Safe Work Practices.** OSHA's Hot Work section is substituted with this policy that requires development of procedures for safe work in the areas of Hot Work, Lockout/Tagout, Personal Protective Equipment (PPE), Confined Space Entry and Elevated Work. Except for PPE, a permitting system was developed for all these areas. The metrics for this policy are the annual number of permits given in each category.
- **Incident Investigation.** This policy defines the timing and type of the investigation after an incident, as well as the format and data requirements of the incident report. Incidents are divided into two types, depending on the severity of the incident and the investigation and report are commensurate with the type. Metrics are the monthly number of incidents and near misses involving employees or contractors, and a monthly report on the number of incident investigations where reports have not been completed.
- **Employee Participation.** Sets the requirements that employees of all levels will participate in all aspects of the PSM System. Specifically, the opportunity for feedback on all S&H policies needs to exist, review of SOPs by operators before approval is required, and at least one experienced operator is required to be part of the team conducting a PHA, a PSSR, a high-severity incident investigation or a formal internal audit.
- **Management System Audits.** This policy requires evaluating the performance of the PSM system by reviewing the facility's compliance with all the S&H policies and procedures. A protocol for the audit is defined as well as the format of the report and the timing for corrective actions, if any. Initially a yearly frequency was set for this audit.
- **Safety and Health Management Review.** This policy determines the manner and timing of the management reviews. In essence, it dictates a monthly review by the Facility Manager and staff of all the metrics that were due for that month as mandated in each policy.

Integration of the PSM System with Plant Operations

Although initially resisted because it represented a significant change in the way that things were done, the PSM System was well integrated into plant operations and became a way of life. Among other items, plans were made to include the MOC number in work orders and purchase orders related to an MOC, in order to verify that all potential changes were recognized and managed accordingly; once a month part of the weekly staff meeting was spent in reviewing the required system metrics; the corporate training tracking database was used to satisfy the training documentation requirements; and a contractor package meeting all the policy requirements, to be handed out to all contractors, was prepared by the authority's Technical Services Group.

Management's Perspective of the PSM System

Management has been extremely supportive of the PSM system from the design phase through its implementation, and its integration to the facility's operation. It is management's belief that the system has not only provided a high degree of safety, but has provided structure and stability to plant operations that have spilled over to other areas of the company. The framework created for the system has been organizationally useful for improved training, company knowledge retention and safety and environmental compliance.

Follow-up and Conclusion

Audits were conducted by the consultant at the end of the initial implementation and a year later. The audits did not reveal any systemic deficiencies—findings were mainly missed actions due to lack of familiarity or insufficient experience on performing required action. All in all, the system is working well and personnel are satisfied that it introduces a higher level of safety to their work environment.