



Process Safety Knowledge Management in Ammonia and Urea Plants

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The Indian Fertiliser Industry comprises of several large scale ammonia and urea plants. Many of the plants are over 10 years old. As the plants age, the management of process safety knowledge becomes critical to avoid incidents. As personnel retire or resign from the organization, their knowledge walks away with them. Here there is a need for a robust process safety knowledge management system to capture and disseminate process safety knowledge. This article discusses various aspects of process safety knowledge management in ammonia and urea plants.

The Indian fertiliser industry comprises of several large scale ammonia and urea plants. The production of ammonia and urea involves the management of process hazards on a day to day basis. Many of the plants are more than 10 years old. Manpower attrition (due to retirements and resignations) as well as modifications and revamps carried out for capacity increase and energy conservation have a direct bearing on process safety if a proper process safety knowledge management system is not implemented.

The difference between, data, information and knowledge is explained below:

Data: Set of numbers or facts (For example, a set of temperature readings).

Information: The set of numbers or facts tells you something (For example, the temperature readings are trending upwards).

Knowledge: It is intangible and uses information to arrive at a conclusion (For example, a trained operator may interpret the trend of increasing temperature and takes corrective action as he knows that the rate at which it is increasing will cause a process upset.)

A comprehensive Process Safety Knowledge Management System comprises of the following elements:

1. Identification of critical process safety information
2. Capturing the results of ongoing Process Hazard Analysis and keeping them updated
3. Capturing changes to operating and maintenance procedures
4. Effective management of change processes
5. The capturing and dissemination of process safety incidents and lessons learnt
6. Institutionalizing process safety knowledge transfer in the training

- process
7. Knowledge Management of the Asset Integrity programme
 8. The use of Process Safety Knowledge Management audits

1. Identification of Critical Process Safety Information

As personnel change, it is important to keep critical process safety information updated and current. Critical process safety information that has a direct bearing on process safety and which normally change over a period of time due to changes, modifications and revamps include:

- Piping and instrumentation drawings.
- Relief system design basis and the calculations to verify relief valve sizing and relief system pressure drop.
- Flare header velocity calculations.
- Flare burner radiation heat area when flaring at full/increased capacity.
- Fluid velocities in pipelines.
- Equipment sizing basis.
- Reaction rates due to new upgraded catalysts and heat removal/heat addition rates.
- Changes in metallurgy due to advances in technology.
- Changes to control valve sizing and their design basis.
- Changes to cooling water flow velocities and distribution.
- Cooling tower upgradations.
- Electrical system upgradations.
- Steam system material and energy balances.
- Shutdown system changes.
- Modifications carried out due to inspection department feedback.
- Changes to operating parameters due to capacity upgradation and their design basis.
- Electrical area classification.
- Ventilation system design basis (for positive pressure systems).
- Changes due to new standards and codes.
- Changes to utilities including nitrogen generation, water treatment and effluent treatment.

- Changes to corrosion inhibitors and corrosion monitoring techniques.

The organization must ensure that the above critical process safety information is tracked and the information database is kept updated and disseminated. Many process incidents have occurred due to the wrong assumptions used in managing changes, revamps or modifications.

2. Capturing the Results of Ongoing Process Hazard Analysis (PHA) and Keeping them Updated

As part of the organization's management of change process, a process hazard analysis (PHA) is normally carried out. Over a period of time, a number of recommendations from an internal PHA are implemented. The organization must ensure that the changes made as a result of the PHA are captured uniquely. A new person who joins the organization 10 years after the recommendation was implemented must be able to understand the need for the change. In many incidents which were investigated, the organization had made a change based on a PHA, but the change was undone a few years down the line by new people who did not have the updated process safety information. This resulted in the incident occurring again.

In many ammonia and urea plants, some of the changes are of a major nature that involves redoing the original risk assessment carried out for the development of the onsite and offsite emergency response plan. The organization must ensure that the assumptions and basis of the revised risk assessment are documented in its emergency response plan. The organization must also periodically revisit the revised risk assessment to ensure that the assumptions and data used for the risk assessment have not changed over a period of time. Specifically, in India, the population data used for conducting a risk assessment changes very quickly due

to hutments and buildings around the factory. This will invalidate the risk assessment and hence, the actions to be taken in the case of an offsite disaster.

3. Capturing Changes to Operating and Maintenance Procedures

Over a period of time, the written operating and maintenance procedures evolve due to modifications and revamps. The organization must maintain a separate data base of such changes and the reason for such changes. This will assist in training the operating and maintenance personnel on the necessity for the change. The changes to the operating and maintenance procedures should be identified uniquely so that a reader is able to identify a change from the original procedure and the reason for that change. Especially important are rates of heating up or cooling down, torque settings for tightening flanges, changes to critical operating and quality parameters and changes to operating and maintenance philosophy.

Changes to operating and maintenance procedures may also have an impact on the work permit system and this should also be captured and documented in the Process Safety Knowledge Management System.

4. Effective Management of Change Processes

Many organizations have established management of change programmes. However, after a period of time, these management of change (MOC) processes become ineffective due to lack of process safety knowledge management. Specifically, the organisation must ensure the following pitfalls are avoided:

a) Changes Taking Place Without Prior Approval

A successful Management of Change program requires the fullest commitment of the top management. Their actions speak louder than words



and the implementation and review of the MOC programme must be continually given great visibility by the top management. This can be achieved by their active participation and support of the programme. Making the MOC programme review a part of their regular review process helps in sorting out problems. If a change does take place without the approval of the MOC committee, the reasons for the non conformance must be investigated and preventive measures implemented.

b) Process Safety Information not Updated

The existing process safety information (safe operating limits and consequences of deviating these limits; maximum and safe operating inventory data; piping and instrumentation drawings; process flow drawings; material and energy balances; design information like material of construction, relief system design basis; emergency interlock system; calculations performed to verify relief device settings and electrical area classification) must be updated prior to the implementation of the change.

c) Lack of Understanding on How to Manage Knowledge due to Reduction in Manpower

Attrition, either due to resignations or retirement drains the organization of valuable process safety knowledge. The reduction of either operating or maintenance personnel in a plant can be safely handled through the management of change process if a human factors evaluation of the following is conducted:

- Assessment of the competency of the remaining personnel in fulfilling the additional workload.
- Distribution of workload during startup, shutdown, turnaround, normal operation, and emergencies.
- Training requirements of the remaining personnel based on the above evaluation.
- Effect of the manpower reduction on

communication during start up, shutdown, turnaround, normal operation and emergencies.

- Capability of the existing work permit system to function without bypassing requirements.
- Intervals between duties for the remaining personnel.

The organization must audit their management of change processes periodically. Having a management of change process does not necessarily mean that process safety knowledge is captured and updated. The organization must also resist the "blind eye" syndrome with management of change - just because it has a management of change process does not necessarily mean that process safety knowledge is being captured, updated and disseminated. The management of change process depends on the competency of the personnel who are involved in the change process. Do not assume competency. Many incidents have occurred even though the change was implemented through the organization's management of change process.

5. The Capturing and Dissemination of Process Safety Incidents and Lessons Learnt

Many organizations are focused on the reporting and investigation of Occupational Health and Safety (OHS) incidents. While OHS near misses and accidents definitely need to be reported and investigated, it must ensure that process safety near misses and incidents are also reported and investigated. For an ammonia and urea plant, dealing with extreme range of temperatures and pressures, the effect of a process incident can have disastrous consequences.

Many plants do investigate plant upsets and trips. But the dissemination of such information is lost in a maze of documentation. After a few years, when people have resigned or retired, the same incident occurs again!

Organizations must ensure the

dissemination of root causes of process incidents (including human factors) and the changes implemented as a result of the recommendations of the investigation. This can be done through the company intranet.

6. Institutionalising Process Safety Knowledge Transfer in the Training Process

The organization must ensure that apart from the regular training programme for newly joined employees (both management and non management), the training process must include the following process safety topics:

- To all newly joined employees:
 - Process incidents that have occurred in their plant, their root causes and the recommendations that have been implemented.
 - Results of PHA studies carried out in their plant and the recommendations that have been implemented.
- To regular employees:
 - Refresher training on changes to process safety information, changes to operating and maintenance procedures, lessons from process incidents, results of PHA studies carried out in their plant and the recommendations that have been implemented, changes to work permit systems and any changes to onsite and offsite emergency response plans.
- To all the personnel involved in the organization's Management of Change process:
 - Changes in engineering standards and codes, sharing of information from process designer regarding process safety, process incidents that have occurred due to mismanaging changes, process incidents that have occurred due to the hazard not spotted in the Process Hazard Analysis used as part of the management of change process.
 - All management of change requests that have been rejected and the reasons for their rejection.

7. Knowledge Management of the Asset Integrity Programme

The management of asset integrity is an ongoing process. This includes the integrity management of mechanical (stationary and rotary), instrumentation, electrical and civil and metallic structures. Management must ensure that the process safety knowledge management system captures and disseminates the following information to those connected with the management of asset integrity as well as those personnel who are responsible for the organizations management of change process:

- Change in inspection, test, preventive or predictive maintenance procedures due to change in code requirements.
- Change in residual life assessment due to change in operating conditions.
- Mean time between failure of equipment covered under the asset integrity programme.
- Changes in management philosophy of inspection frequencies.
- De-rating / rerating of equipment.
- Repair history of equipment.
- Process Incident reports of incidents caused due to equipment failures.
- Changes in corrosion monitoring programme.
- Reclassification of risk based inspection criteria.
- Competency requirements during outsourcing of inspection jobs.
- Engineering data sheet changes due to modifications, rerating, de-rating, change in code requirements etc.
- Change in spare parts inventory management.
- Localization of spares.
- Changes in acceptance criteria for results of preventive and predictive maintenance procedures.

8. The Use of Process Safety Knowledge Management Audits

The organization must not only audit their process safety management systems periodically, but also

specifically audit the management of process safety knowledge. The process safety knowledge management audit should focus on whether the knowledge captured in a fragmented way or is integrated with the organization's way of working. An audit of the Process Safety Knowledge Management system should include the assessment of the following:

- Analysis of decision making support system for Process Safety.
- Assessing the alignment of the process safety knowledge management system with business objectives and long term strategy.
- Identifying the process safety knowledge gaps in the existing system.
- The analysis of root causes of process incidents to determine if gaps in process safety knowledge management was one of the root causes.

CONCLUSION

Having a process safety management system in place does not necessarily mean that process incidents will be reduced or minimized. Trevor Kletz has said "Organizations do not have memory". This is extremely important for plants which are aging and attrition rates are high due to retirements or resignations. A process safety management system is like the skeleton of a human body – it provides the framework for managing process safety. However, the process safety knowledge management system is like the nervous system of the human body. Without it, the framework will be useless.

It is often observed that a process incident is repeated after a period of time. After a process incident occurs, a number of actions are implemented. Then, after a period of time, people associated with the incident either retire or resign and the incident occurs again. Only an effective process safety knowledge management system can prevent this from occurring. ■

VIDEO FILM COMPETITION FAI ANNUAL SEMINAR 2010 REFORMS IN FERTILISER SECTOR

FAI will be organising, as in the past, a Video Film Competition during this year also. The focus of Video Film could be related to technical, marketing or agricultural extension areas. The theme is open and the film may cover any topic like training personnel on safety, extension or a message to farmers regarding the use of fertilisers, etc.

* The Competition is open only to FAI members.

* A Member can send only one entry.

* The best and the second best films will be awarded a Plaque each at the Inaugural Session of the

FAI Annual Seminar 2010 –
Reforms in Fertiliser Sector
on **November 29, 2010**.

* The duration of the film should not exceed 15 minutes.

* The film can be in any language. A brief write-up on the theme of the film (not exceeding 100 words) should accompany the video film.

* Only those films produced after **January 2008** are eligible.

* Award winning entries of previous years cannot compete for the award.

* **Entry Fee Rs.10,000/Film.**

* The VCD/DVD along with an Entry Fee of **Rs.10,000/-** (DD drawn in favour of The Fertiliser Association of India) should reach FAI positively by **November 5, 2010**. Entries received after due date shall not be considered for the competition.