

## **SAFETY AUDIT OF CHEMICAL PLANTS**

**P. K. Ghosh, U. K. Paul & S. M. Kodolkar**

*Industrial & Radiation Safety Division*

*Atomic Energy Regulatory Board*

*Mumbai - 400 094*

### **SYNOPSIS**

As a part of the project of the Ministry of Environment and Forest, Government of India, the Atomic Energy Regulatory Board carried out a Districtwise hazard analysis for one of the major hazard industrial pockets near Mumbai in the state of Maharashtra. Safety Audit constituted a major part of it and the methodology used for conducting the Safety Audit, the documents referred to obtain information, and outcome are presented in this paper.

### **INTRODUCTION**

Traditionally, chemical plants were considered safe if their design and construction complied with the relevant engineering codes and standards. It is now acknowledged that mere compliance with codes and standards is not sufficient to ensure plant safety. The indices such as frequency rate, severity rate, injury index, etc. are widely used to assess an operating plant's safety status. The indices are quantitative rather than qualitative and they measure results of personnel safety only. There do not cover the quality of a plant's safety efforts and fail to focus on the strong and weak points in the different areas safety.

What is needed, therefore, is a method which will give a reasonable indication of how well a company's safety programme is working in all its aspects; how hazards are being recognised and controlled, how unsafe acts are eliminated how accidents are avoided. A safety audit reflects quality of the safety status of a plant as a whole.

As a developing nation, India pay much importance to industrial development and accordingly various types of manufacturing industries comprising of large-scale industrial complexes such as fertiliser, petroleum, chemicals etc. being set up. These large industrial units not only present economic advantages but also increase the hazard potential by using handling and storing large quantities of hazardous chemicals. The risk of handling large quantities of hazardous chemicals came into sharper focus after the Bhopal accident in 1984. This resulted in the addition of Chapter IV-A for hazardous process in the Factories Act, 1948, while amending it in 1987. The Manufacture, Storage & Import of Hazardous Chemical (MSIHC) Rules were promulgated in 1989.

In order to help the Ministry of Environment and Forests to assess the state of preparedness and risk reduction measures and strategies that could be adopted in various industrial pockets, a scheme entitled Districtwise Hazard Analysis was formulated by the Ministry. It was proposed to identify major hazard units as per the MSIHC Rules in each of the industrial pockets and carry out a safety audit and a consequence analysis of worst accident scenarios. The Atomic Energy Regulatory Board was assigned to carry out a Districtwise Hazard Analysis for two industrial pockets. The experience from one of the pockets is described below.

## **AUDIT METHODOLOGY**

The detailed methodology depends on the size of a plant and its activities. However, there are some general principles, which can be applied to all situations. They are covered under the five main aspects as given below:

1. Identification of possible hazardous situations
2. Assessment of consequences associated with these hazards
3. Selection of measures to minimise consequences
4. Implementation of these measures within the organisation
5. Monitoring and documentation of the changes

The methodology generally accepted and adopted for safety audit is the preparation and submission of a questionnaire or checklist to the plant management. If the questionnaire is carefully prepared, the answers can reveal many of the key areas needing attention. The actual auditing preceded a discussion of the completed questionnaire with the management.

The various areas, which were broadly covered in the safety audit, include:

- 1) Organisation and administration
- 2) Industrial hazard control
- 3) Fire control and industrial hygiene
- 4) Supervisory participation, motivation and training
- 5) Accident investigation, statistics & reporting procedure

Each area was further sub-divided and information with respect to all of these were collected through the reply to the questionnaire, discussion with the plant management and operating personnel, study of the systems/procedures available and visit to the plant areas.

The positive and negative points with respect to each of the aspects were listed out. They were also graded into categories such as poor, fair, satisfactory, good or excellent. The deficiencies observed in each of these areas were translated in the form of recommendations.

It is imperative that the recommendations should be practically possible to implement since many suggestions are difficult to retrofit in an already existing plant. The draft report along with the recommendations was also circulated to the implementing agencies for their views before the report was finalised.

It is also possible to quantitatively estimate instead of above by a marking system for each of the aspects studied.

## **REVIEW OF DOCUMENTS**

It is an essential requirement of an audit system that it should originate with the policy-making authority and that the system and its objectives shall also be meaningful to the line of management who, after all, must also be prepared to place before the audit team all the documents.

The safety audit should covers the objectives laid down and aim to promote participation of individual workers towards achieving better safety status in plant as a manifestation of management's interest and concern to gain their involvement; to encourage comments and suggestions relating to safety.

In order to fulfill the above mentioned requirements, the documents such as safety policy, safe operating procedures, emergency control plans, plant safety rules, maintenance schedule, job safety analysis, minutes of the safety committees were reviewed during the safety audit.

Safety policy was checked for safety, health and environmental aspects, responsibilities of the workers and management, availability of loss minimisation statement in the policy and periodicity of review of safety policy etc.

The emergency start-up and emergency shutdown procedure and their review procedures were reviewed in the safe operating procedure.

Emergency control plan was assessed for various types of emergencies, responsibilities of every individual, key person and provision of back-up key person's.

Plant safety rule was assessed for various types of precautions to be taken and rules to be followed in the plant for various activities. The procedure of review of plant safety rules & their enforcement methods were also checked.

Availability of maintenance schedule for dangerous and rotating machines and its implementation as per statutes and manufacturers guidelines was checked.

Job hazard analysis report was reviewed for methodology, description of events, hazards from the events and their remedial measures including personal protective equipment.

Reviewing through the minutes of the safety committees, and internal/external inspection or audit reports prioritisation of the recommendations and their follow-up action were checked.

## **ADVANTAGES OF SAFETY AUDIT**

The following were the benefits, which resulted from the third party safety audit:

- i) It was a systematic and comprehensive procedure, which reviewed safety status of the entire facility.
- ii) It was an independent review by persons who are not associated with the plant operation – in future a team comprising of personnel from different departments in the plant, the corporate office personnel or an agency external to the company may carry out a safety audit.
- iii) It was site specific and focused on the safety requirements based on the nature and scale of operations carried out in the particular facility.
- iv) The audit reviewed the availability and the adequacy of the documents in the units. It also commented on the adequacy of procedures e.g. safety permits and recommended modifications in them wherever required.
- v) The changes that have occurred since the last audit were focused upon in units where carrying out the audit is a regular feature. This brought out the improvements in the safety status as a result of carrying out such an audit.
- vi) The audit took a fresh look at the areas, which needed improvement.
- vii) It encouraged good practices and discouraged bad practices in the plant.

The acceptability and implementation of the recommendations of the safety audit by the management depends upon the confidence the management has on the auditor and the suitability of the auditor/s for carrying out such a review.

In general the four industries in which the safety audit was conducted were found to have achieved a good safety standard. However, it was felt that if following measures were taken, improvement in safety would take place and safety status improve.

1. A well-documented safety policy is prepared.
2. Housekeeping is given a very high priority.
3. Chemical hazard control is properly understood.
4. Training is given a very high priority.
5. All accidents are investigated to find out root cause.

## CONCLUSION

With the aid of the completed questionnaire and plant visit a report was prepared and discussed with the plant management. These discussions were a part of the formal procedure for considering the recommendations leading to the preparation of an action plan. A monitoring system was required to ensure that recommendations were communicated to proper agencies and that the required work or changes were implemented. The methods of achieving this within the allotted time scale would be the responsibility of the plant management in liaison with the corporate safety office. The regular discussions between the safety engineer and plant management were certainly necessary to monitor the progress of implementation. It was also necessary that the recommendations were prioritised based on the safety implications. The concerned agency should give feedback to the top management at periodic intervals with respect to the implementation of the recommendations of safety audit. The main outcome of the safety audit should be that hazard was reduced due to implementation of the recommendations.

The achievement of good safety standard is not a one-time occurrence, rather it is part of a continuous process which has many and good side effects.

In fertiliser plants the aspects related to housekeeping and industrial hygiene need more concentrated efforts.

In petrochemical plants care should be taken in the area of housekeeping.

In refineries it is required to ensure the adherence to the existing permit system and proper understanding of the background reasoning of each items in the permits.

The date of updating should be mentioned in all safety-related documents.

The safety audit conducted in the four major hazard industries revealed the fact that loss of containment of the large pressurised storage tanks for various hazardous chemicals, when inventory is full, may lead to off-site consequence.

However, the point to be noted here is that from the safety audit conducted it appeared that the possibility of a major accident having off-site consequence is remote in the four industries.

The specific recommendations were suggested in the four units for further improvement of safety standard of the plants.