OPERATIONAL SAFETY REVIEWS

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Operational Safety Reviews, developed during 1997 at Melinex Dumfries, amalgamate features similar to parts of ICI's Process Hazard Review (PHR) technique and the DuPont (ex ICI) Wilton Melinar Plant's Production Task Review. A key element is the use of simple risk ranking to prioritise issues. The actual sessions, conducted using teams with high shop-floor content, encourage an open approach and review what actually happens. The Reviews are suitable for application to safety, occupational health and environmental issues on all kinds of Plant or operation with significant operator interactions. They differ from conventional Hazop and PHR methodology in their ability to focus more effectively on the causes of major and minor injuries and on ergonomic problems to operational staff.

INTRODUCTION

In early 1997, the management team for the Melinex production facilities on the then ICI site at Dumfries were concerned about a levelling off in the trend of continuing improvement in industrial injury performance. Targets being set by the Business and ICI (at that time the owners) were at the same time becoming ever tighter. These concerns were further highlighted in April when a Process Operator sustained serious burns while establishing a Melinex film line. Senior Management within the Business and on Site were aware that some film lines had been built before the creation of the ICI Hazard study process while for other, subsequent lines, only some sections of the equipment had been subjected, at the design and installation phases, to Hazard Studies. On the other hand, it was appreciated on Site that these Hazard Studies (The ICI Studies 1-6, Refs. 1 & 2) with their main focus on the integral safety of the equipment, would probably not in themselves have effectively designed out or prevented this particular injury, or many others where Operator behaviour or action is a major contributory factor.

However, it was, and is, recognised that Hazard Studies have contributed to the inherently safer design of new and modified Film making plant, particularly when carried out by an experienced team at the appropriate stage of the project. Even so, it has been found necessary to develop different guidewords and often additionally use a FMEA (Failure Mode and Effect Analysis) approach to cope with the Film Plant technology which is inherently different from that of the Chemical Process Plants for which the Hazard Study technique was originally developed. One option considered, therefore, was to embark on a programme of comprehensive retrospective Hazard Studies. Reluctance to pursue this course arose from:

- previous experience on another plant of achieving limited value for significant time and effort when Hazard Studies are retrospective, and
- the realisation, as mentioned above, that even if the effort were to be put in, that Hazard Studies would not focus effectively on Operator behaviour, concentrating instead mostly on how the equipment was likely to malfunction.

It was decided that there was a need to carry out some other kind of retrospective study on the older units that would include looking at behavioural aspects. The Plants were already going through a comprehensive series of "Do Not Touch!" studies (Ref.. 3) where Operators under an experienced Study Team Leader reviewed the hazards of entrapment from moving machinery and from film, but it was recognised that the new technique would need to address a wider range of hazards than this.

Eutech were consulted because of their experience with the Process Hazard Review (PHR) technique (Refs. 4 & 5) that had been developed initially by ICI's Teesside Operations to study retrospectively Plants on Teesside that had predated Hazard Studies. It was hoped that PHR could be used flexibly enough to meet the requirement, but on review it was felt that although this technique would contribute significantly to the requirement by considering how the equipment could malfunction, it did not lend itself to effectively reviewing the behavioural risks. Like Hazard Studies, the PHR technique had been developed to identify potential hazards from chemical plant and equipment, reducing the risks of explosions, toxic releases, losses of containment etc., rather than effectively focusing on how individual operational staff could suffer injury from their own behaviour.

In addition the Melinar Plants at Wilton (at the time under ICI ownership, but since transferred to DuPont like their Melinex equivalents at Dumfries) had developed a process that they called Production Task Review (PTR) (Ref.6) that focused entirely on behavioural aspects. PTR involves a Plant team first developing a list of all the tasks carried out by Operators and Tradesmen in the area under study. The Team then assesses the risks (potentially H and E as well as S, though studies to date have concentrated on S) associated with each task and decides whether steps are needed to be taken to reduce them. Activities considered high risk are labelled "Critical Tasks" and are subject to further specific study. This technique was recognised as being capable of providing the basis of the required review of the behavioural aspects that could then complement a PHR style study.

The Operational Safety Review procedure owes debts of gratitude to both PHR and PTR and like a human child that has many of the characteristics of both parents, it also has significant differences from either one parent taken individually.

An important requirement of the Operational Safety Review process is to direct the efforts of the team to the particular topics that require attention. This is achieved by starting from a general overview of the area being studied. Progressively more detail is then introduced but only in conjunction with the use of risk level as a filter. Areas of low or no risk identified in a rapid and subjective filtering process are noted in the records but then no longer addressed. The study team is then able to focus its efforts on detailed consideration of the matters of significance that have not been filtered out. In practice this has been found to be an efficient process, allowing a typical limited area of Plant operations to be reviewed in a single day.

PRELIMINARY STAGES - SCOPING AND INITIAL DATA GATHERING

Required attendees at the Meeting are a First Line Manager with responsibilities for the area together with experienced Operators and perhaps Tradesmen. In some cases a Plant Engineer or Plant Manager may also be able to contribute usefully. The Study Leader should be someone used to chairing Plant level Hazard Study Meetings or similar and have an understanding of the nature of the Plant operations being considered. They need to be able to gain quickly the trust of the operational staff as the Meeting is seeking to consider what actually happens (which may not be quite what is supposed to happen according to the Plant's Operating Instructions).

The Review Meeting starts by agreeing the defined boundaries of the area and activities being considered and will reference drawings, flowsheets or engineering line diagrams that are needed to assist the study. A check is then made of potential or perceived interactions with adjacent areas or activities that could have adverse effects both in the area under consideration and in areas adjacent. An example of this could be that heavy Fork Lift Truck traffic through the area being considered that is not part of the area activities can add to the hazards. Another example is that a spill to drain on one part of a Site could have limited consequences locally, but might have more serious consequences elsewhere on the Site.

The next step is to ensure that Materials Hazard Data is available for all the materials used or encountered in the area and that appropriate COSHH (Control of Substances Harmful to Health) Assessments have been carried out. Typically this would also cover items such as confirming that building and insulation materials in use do not contain asbestos.

Finally, at this stage, the Meeting reviews the Injury Accidents and Dangerous Incidents that have occurred in the area. It is also usually considers engineering failures that have adversely affected process operations even if these have not directly been dangerous. Such failures can often lead to non-standard operation with incumbent increased levels of risks as well as their obvious economic impact.

It will be seen from the above that it is desirable that a certain amount of information gathering occurs prior to the formal meeting. This is usually best done by someone who will be participating in the study. Depending on the nature of the activities, additional work may also be required by Maintenance or Engineering staff.

This stage of the Review often raises Actions to gather further information for subsequent review and it is not uncommon for the Team to consider that the "Actions to prevent recurrence" raised at formal investigations into injury accidents and dangerous occurrences have not been totally effective. The Team may also be prompted to raise Actions suggested in the discussion to consider further or remedy specific situations where unacceptable risk is thought to be present.

Any issues with attendant risk are allocated a "Risk Level" from a simple matrix (see Appendix 1). The "Harm Levels" and "Probabilities" are taken by the Team and benchmarked against the tolerable levels set by the Site or Company. Taking injury as an example, "Severe"

would be "potentially disabling or fatal" with the corresponding "Rare" being not foreseeable at a frequency higher than the Company's tolerable frequency for such accidents. "Likely" would be a significant probability (say 0.2) of the accident happening within the Plant's life (say 30 years) and "Unlikely" being between "Rare" and "Likely". The judgements are deliberately kept simply empirical with guidance from the Team Leader to avoid time debating which category applies.

The Risk and Precaution Guidance Table (see Appendix 1) indicates the nature of the Action that will be required to satisfactorily resolve problems at the 3 different Risk Levels.

REVIEW OF EQUIPMENT ISSUES

The second stage of the review is similar to parts of the PHR process with the addition of the simple Risk Rating and considers whether particular problems are possible in the area or activities under consideration. Many of the prompts are derived from PHR prompt sheets. The first 4 topics are compulsory, but the second 4 can be screened out if not relevant. The compulsory topics are (1) Health Issues, (2) Releases to the Environment, (3) Mechanical and other Abnormalities (Weather damage, etc.) and (4) Services Failure. Each topic has a prompt sheet that should be completed even if the response to the "Relevant ?" prompt is "No".

The sheet for Health issues is attached as Appendix (2) to demonstrate the format. Note that a "Risk" rating is applied to each relevant prompt. The hazards or problems are rated by the Team as "High", "Medium", "Low" or "Zero" Risk. Further consideration is given to Medium and High Risk rated issues, but not necessarily to Low Risk issues unless the Team wishes to do so. As in a Hazard Study or PHR, Actions to cure or alleviate the problems are progressed and decided upon outside the meetings and not as part of the Reviews. The Operations Review sessions are charged with addressing current operations and problems but not with identifying the solutions to any issues identified. This clarity of purpose is needed to avoid the Meetings becoming bogged down in detailed debate of optimum solutions.

The optional topics are (5) Web Handling and Cutting (equipment issues relevant to films production processes), (6) Fire and Explosion, (7) Uncontrolled Reaction and (8) Physical Over/Under Pressure. Where relevant these topics are treated in the same way as the compulsory ones.

This part of the study looks at issues arising from the hardware and materials and picks up issues that would probably be found through PHR or retrospective Hazop. By applying the filters of operational experience with the actual equipment and the risk rating, it is possible to focus on the key issues. This has been found in practice to be quite streamlined and certainly an order of magnitude less time consuming than applying the Hazop procedure to the same parts of the Plant. An experienced PHR Team would also be able to skip minor issues and only concentrate on those that are more important, so the time savings against this technique are less clear cut. The authors, though, do believe them to be significant.

The technique is readily adaptable to other technologies than Film Production and Chemical Manufacturing, but if this were to be done, it may well be desirable to draw up further topic specific prompt sheets first. For instance, if bulk transport by road is being considered, a topic sheet with prompts relating to the specific nature of hazards that would be relevant rather than

those used in the studies carried out so far. A short brainstorming session between the potential Team Leader and the relevant Operational/Safety management can produce the required prompts.

REVIEW OF BEHAVIOURAL ISSUES

The third stage is the Task Review which focuses on activities performed by the people associated with the operating units. It starts with a prompt sheet that helps decide which kinds of "Activity" need to be studied for a particular segment of operations. For instance, the Team may feel that "Frequent cleaning" and "Routine Control/Electrical on-line maintenance" activities have no specific hazards attached to them and so these activities do not need breaking down into specific Tasks and further study. The sheet prompts at least a brief consideration of activities that could otherwise easily be overlooked such as "Response to process upsets" and Trades activities such as scaffolding and lagging, but this process is rapid and quickly filters out activities that are not hazardous. The Prompt sheet is attached as Appendix 3. Again streamlining of the study arises from using the risk level as a means of focusing attention on the higher risk activities.

Where a type of Activity is deemed to require review, the Team lists all the Tasks associated with it. (A sequence of "Tasks" make up an "Activity") This is where the Team's operational experience is important as it is essential that the description is of what actually happens, not what the Job or Operating Instructions say should happen! It is worth having the formal Operating Instructions available for reference, but the focus must be on what happens in practice, remembering that different shifts may well have developed different methods. When the Tasks have been listed for an Activity, the sheet attached as Appendix 4 is completed by the Team. Team members have in front of them a prompt sheet of potential hazards covering Injury Potential, Spillage Potential and General Hazards. The latter includes reminders that there can be communication failures, Permit to Work misunderstandings, inadequate isolation, etc.. Ergonomic issues that can lead to back strains and other problems are also considered. The risk level for each Task is assessed and any Actions decided upon. As already mentioned for other problems raised, "Medium" and "High" risk Tasks will always be given further consideration, although usually the Action is to see what mitigation measures are possible outside the Meeting. Actions are only raised on Team members so there is no passing of responsibility onto managers or engineers not present. Experience has shown that the Teams become enthusiastic in their desire to reduce the risks and in practice many Actions are also raised for improvements to "Low" risk Tasks.

MANAGEMENT PRIORITISATION OF OUTCOME

Many of the Actions can be pursued to completion without recourse to more senior management approval, but others requiring expenditure or engineering effort will usually need to be fitted into (generally already over-full) Plant programmes. There is thus usually the need for a mechanism to enable review of the Actions raised with more senior Operational management and for priorities to be assessed. This is not part of the formal "Operational Safety Review" procedure as each Plant tends to have its own mechanisms already in place for doing this. All the same, it is essential that this is done or a lot of the effort already put in by the Team will come to nothing.

CONCLUSIONS

At the time of writing (Spring 1998), the technique has been applied to 8 areas on 2 Plants belonging to Melinex Dumfries. The change of ownership (ICI to DuPont) of the Melinex Business announced during the Summer of 1997 and implemented at the end of January 1998 has led to a pause in the implementation programme but it has only been a pause as Reviews are again underway with a year end target date for completion on the largest plant on site. Operations Reviews are also in progress at the Melinex Hopewell site in the USA, following training in the technique of a Hazard Study Leader there.

On the 2 Plants at Dumfries where the technique has been used and at Hopewell the response has been enthusiastic at all levels from the Team Members to the Plant Manager. The participants feel that they are focusing on real issues that affect them and that the reviews provide a realistic route for improving SHE performance. The operating teams are now requesting studies and setting priorities for the order in which reviews should be conducted on the different areas.

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(2) "Hazard Studies for Safety, Health and Environmental Protection - Application to Existing Plants and Processes" - Paper by R.D.Turney to the European Conference on Safety and Loss Prevention in the Oil, Gas and Process Industries, London 1991.

(3) "Do Not Touch" - Presentation by D.Shields to Melinex Management Team, Spring 1997.

(4) "PHR - A Programme of Safety Assurancefor Existing Operations" - Paper by R.A.McConnell to AIChemE Symposium, Los Angeles, 1991.

(5) "PHR - Improving Safety, Health and Environmental Protection on Existing Plants" - Paper by R.D.Turney and M.F.Roff to the 8th International Loss Prevention Symposium, 1995.

(6) "Production Task Review Methodology and Training" - Presentation to the ICI European SHE Exchange by S.M.Heppell and R Cheyne, Manchester, Spring 1996.

Appendix 1

Risk Levels

Probability	Rare	Unlikely	Likely
Harm level	(1)	(2)	(3)
None (0)	Zero	Zero	Zero
Minor (1)	L (1)	L (2)	L (3)
Moderate (2)	L (2)	M (4)	M (6)
Severe (3)	L (3)	M (6)	H (9)

Risk & precaution guidance table

Risk	Low	Medium	High
Precaution	(1-3)	(4-6)	(7-9)
Eliminate or Substitute	✓	✓	✓
Reduce consequences or use PPE	✓	✓	?
Use procedural & training approach	✓	?	X

Appendix 2

Health Issues

Issue	Relevant?	Comment	Risk
Hazardous materials Carcinogens Asbestos Corrosives Asphyxiants Skin sensitisers Respiratory sensitisers			
Manual Handling			
Repetitive activites			
Temperature extremes			
Noise			
Radioactivity			
Infra red and UV radiation			

Appendix 3

Task Review Prompts

Production		**Review Required - Y/N**
Start-up activities		
Shut down activities		
Routine monitoring	Frequent	
	Infrequent	
Cleaning	Frequent	
	Infrequent	
Process adjustments (incl. Grade changes)		
Process upsets		
Material transfers (incl. Reel changes, scrap disposal, etc)	Arrivals (deliveries)	
	Departures (despatches)	
Maintenance		**Mech C/E**
Routine	On line	
	Off line	
Breakdown response		
Fault finding		
Schedules work		
Other Trades Work		
Lagging		
Scaffolding		
Civil/Structural		