

## The Discipline of Process Safety Management and How It's Relevant to the Pulp and Paper Industry

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### Abstract:

Process Safety Management is application of management principles and systems to the control of process hazards to prevent process-related loss. It has evolved from developing purely technical solutions to applying crisply focused management. In many countries, chemical engineering societies provide the organizational leadership to advance PSM. The third edition of CSE's "Process Safety Management" guide, published in 2002, is really a guide to applying chemical engineering discipline and methodology to increasing the performance efficiency of a process operation, in all its aspects. We all gain when we make our operations and our communities safer for everyone.

### Introduction:

The Canadian Society for Chemical Engineering (CSE) is the national technical association representing the chemical engineering profession and the interests of chemical engineers in industry, university education and government. Our organization seeks to promote understanding of the social and environmental consequences of the application of chemical engineering, as well as of the benefits to the public. Over its first three decades since its founding in the late '60s, our Society had been very academic in focus.

The modern discipline of Process Safety Management originated in the mid-80s in the aftermath of Bhopal, Three Mile Island and Chernobyl. Closer to home, the succession of relatively low-impact pulp mill chlorine and chlorine dioxide emissions re-emphasize the fact that incidents can and do happen. The focus of PSM is improvement of process safety in the transportation, utilization, processing and storage of hazardous materials. The initial thrust, beginning over fifteen years ago, was highly technical in nature. Since then, it has become increasingly more apparent that major accidents cannot be prevented by technology alone. The evolution of process safety from a purely technical issue to one that demands crisply focused management tactics has been essential to continued improvement and has broadened the applicability of the discipline.

The CSE Process Safety Management Division was established in the Fall of 2000 to be the successor to the Major Industrial Accidents Council of Canada, MIACC PSM Committee which had, in turn, been started in 1990. MIACC's efforts and focus have been carried forward through this new subject Division. This PSM Division aligns with the efforts of the Canadian Chemical Producers Association

Process Safety Management Committee and brings a practical and societal focus to the CSChE, making it an organization with a greater focus on the industrial sector.

This newly launched Division gives CSChE members a forum for highly visible application of their professional capabilities for the benefit of society through focused efforts to make our communities safer places to live. And the PSM Division also gives the MIACC efforts a home in the form of a decades-old established society of pertinently qualified professionals. The Division works in concert with the Canadian Chemical Producers Association Technical Management Committee and with the Canadian Association of Fire Chiefs Partnerships Towards Safer Communities working group. We work to promote awareness, understanding and use of PSM services, techniques and tools in Canada including facilities involved in manufacturing, distribution and consumption of potentially hazardous materials.

The Division Executive Committee, as currently constituted, includes representation from energy suppliers and industrial chemical producers such as Nova Chemicals, Syncrude Canada, Nexen Chemicals and industrial consumers such as Pope & Talbot Ltd. It also includes participation from the Canadian Chemical Producers Association, the Communications, Energy and Paperworkers' Union of Canada, two university chemical engineering departments (Alberta and Dalhousie) and three risk management consultants.

#### Definition of Process Safety Management (PSM)

Process Safety Management involves the application of management principles and systems to the identification, understanding and control of process hazards to prevent process-related injuries and accidents. This is more than simply chemical safety. As you dig into it, you will see it is really a guide to applying chemical engineering discipline and methodology to increasing the performance efficiency of a process operation, in all its aspects. As the discipline has developed, it encompasses twelve elements:

1. Accountability
2. Process Knowledge and Documentation
3. Capital Projects Review and Design
4. Process Risk Management
5. Management of Change
6. Process and Equipment Integrity
7. Human Factors
8. Training and Performance
9. Incident Investigation
10. Standards, Codes and Regulations
11. Audits and Corrective Action
12. Enhancing Process Safety Knowledge

Let's take a look at how these crucial elements are relevant to the pulp and paper industry.

## #1: Accountability

This covers continuity of operations, systems and organization, the quality process, control of exceptions, utilization of alternative methods, management accessibility, communication discipline and company expectations.

Successful process safety management makes senior managers accountable for being accessible to their people for support and guidance in decision making and for resolving priority conflicts among safety, production and cost control. Managers must communicate process safety accountability so there are no gaps in coverage. You have to lead from the front, not from the top. Management must communicate philosophical and specific aspects of process safety management and make it compatible with constraints and availability of resources.

Management accountability, at all levels, is where you put the “teeth” into your best intentions. One place to lock in this commitment is to translate those intentions into standards in each renewal of performance plans, annually or more often. This makes it possible to commend or correct accountability performance at salary review time.

## #2 Process Knowledge and Documentation

This is where you have to opportunity to institutionalize your organization’s collective experience and wisdom. This element covers chemical and occupational health hazards, process definition and design criteria, process and equipment design, protective systems, operating procedures, process risk management decisions, information management.

Operating procedures must be readily accessible and up-to-date! They must cover startup, normal shutdown, emergency shutdown and safe restart as well as normal operating conditions, reasons for them and how to correct deviations.

There’s a growing tendency for this management of information to be performed electronically, making knowledge readily accessible from computer terminals at critical locations throughout the mill. Centralized common access makes it easy to provide updates on a timely basis. The caution however is you must use hard copies very prudently since there is no assurance they are current!

## #3 Capital Projects and Design Procedures

This element is less applicable to ongoing general operations but very relevant to the once per life cycle considerations involved in construction a new facility. On the administrative level, it includes appropriation request procedures, hazard reviews, mill siting considerations, plot plan for optimum operability and safety, process design review procedures, project management procedures and controls.

On the operational level, it is your one chance to get things absolutely right in the first place. This is a system for performing qualitative hazard and operability reviews from process concept inception until process startup. Go right back to basics, looking rigorously at the design intent for each component. The review must

then loop back to the company's project management system to communicate identified hazards and suggested improvements to process development/design teams. These same methods are also applicable to modifications of existing facilities.

#### #4 Process Risk Management

This covers hazard identification and operational risk analysis and alternative approaches to risk reduction. Management of residual risk, process management during emergency situations, supply chain risk management and the concept of tolerable risks all must be considered. Hazard identification is the most important aspect of risk management. If threats and opportunities are not identified, they are not addressed!

Risk optimization requires that you understand the experience, culture, systems and environment aspects of your total risk situation. Early on you must acknowledge the utter impossibility of eliminating all risks. You must optimize by clearly stating objectives, identifying threats and opportunities, and assessing impacts and abilities. After assessing all relevant factors in your total risk situation, you select the strategy to pursue. Maybe you decide to stop, or at least minimize some critical negative factor. Maybe you decide to start or maximize some factor with significant positive impact. After that, you may decide to live with the residual risk or partially share it with someone else through some form of insurance.

#### #5 Management of Change

Change management has become a management buzzword over the past fifteen years. Our context is narrower. It refers specifically to changes in process technology, the physical facility, the way the work force and management team is organized and aligned and procedures for dealing with variance. Always be on the lookout for permanent changes as opposed to temporary changes and how the latter can drift into the former! And be forever alert to the unintended byproduct change... something subtle that changes as the result of the major visible change.

You need a system to prevent the introduction of new hazards or an unknown increase in the risk associated with existing hazards resulting from modifications to mill operations. The system must establish a formal, documented authorization process for all changes that are not simply replacements-in-kind.

#### #6 Process and Equipment Integrity

The span of consideration here includes reliability engineering, materials of construction, fabrication and inspection procedures, installation procedures, preventive maintenance and pre-start safety reviews. Also covered in the facet is the once-per-lifecycle decommissioning and demolition discipline. Preventive maintenance efforts must identify critical units, establish frequency, ensure discipline in performing the schedule as developed and ensure proper keeping of records!

Alarms and instrumentation are often overlooked because they do not necessarily show up as reportable lost tonnes. But they do represent potential losses in process efficiency through quality variability and chemical consumption and they do pose safety implications! It is essential to identify what's critical and to apply control to possible changes. There must be a regular check and test discipline.

Excellence of operational execution is the result when process performance and equipment reliability converge.

## #7 Human Factors

Human beings are not robots. This element covers steps taken in advance to manage the operator/process-equipment interface. You have to take into consideration both procedural administrative control and design-out hardware control. Human error assessment must be taken into account in applying both.

Human error management means you have to acknowledge that human error is a fact of life. That must be incorporated into design and effort must be focused on both prevention of occurrence and minimization of impact. The range of coverage includes procedures, audits, communication and the mastering the essentials of the "person-process" interface.

## #8 Training and Performance

Training is a much broader topic than fits the scope of this presentation. Within the current frame of reference, we are talking about a systematic approach to selecting and developing programs to train mill personnel on the operation, maintenance, and emergency actions associated with mill processes. Ensuring an effective instructor program is part of the scope. Start by clearly defining the skills and knowledge required.

The system should include assessing initial qualifications and then providing not only initial but also on-going refresher training at appropriate intervals; training documentation must be developed and maintained. This system also addresses the training of mill personnel on how to participate in the operation of the mill's PSM system. The job is not complete until you measure performance and critique the effectiveness of the training effort.

## #9 Incident Analysis

Note that I am using the term "analysis" rather than the more traditional "investigation". Analysis implies a process less judgmental and signals more openness to learning from experience. Learning from incidents means you must analyze even the potentials, the near miss situations. Do the analysis promptly and involve competent knowledgeable people; use third party participation if appropriate.

The resulting report includes sound, root-cause identification and following up with action to prevent recurrence. If the analysis report does not clearly state who is going to do what by when, it simply has not done the job. Communication of the

outcome is essential so that all parties involved and interested know what is going to be done differently from now on.

#### #10 Company Standards, Codes & Regulations

This is where you come to grips with corporate governance considerations and the higher level fiscal responsibility involved in insurance coverage. There must be a systematic approach to developing, acquiring, evaluating, disseminating, and maintaining an archive of standards, codes, and laws. It creates and maintains company standards, whether they match or exceed relevant external codes and regulations and keeps this information up-to-date and accessible to potential users.

#### #11 Audits and Corrective Action

This is a system that can be considered the precursor to ISO 18000 registration of a mill health and safety system. It applies the ISO discipline many of us have already been exposed to in quality (9000 series) and environment (14000 series) for scheduling, staffing, performing, and documenting audits of process safety management systems and operating processes. It manages the resolution of findings and corrective actions generated by the audits.

As the approach matures and evolves, it will encompass process safety audits, compliance reviews, and systematic use of internal and external auditors.

#### #12 Enhancement of Process Safety Knowledge

The need to design for continuous improvement means there must be a system to proactively seek out new process knowledge and documentation from internal and external sources. Knowledge of technology and systems is growing and concurrently safety requirements are becoming more stringent. So the need for ready access to relevant information is crucial.

Earlier approaches to process safety management did not include increasing process safety knowledge as an explicit element, although some addressed the general intention through overall policy statements.

#### Convergence

The modern era of the process safety management discipline began in the mid-80s in the aftermath of Bhopal, Three Mile Island and Chernobyl. In 1985, the American Institute of Chemical Engineers formed the Center for Chemical Process Safety (CCPS) to promote the improvement of process safety among those who transport, consume, process, and store hazardous materials. The first projects supported by CCPS were highly technical in nature. CCPS recognized, however, that major accidents could not be prevented by technology alone. The evolution of process safety from a purely technical issue to one that demands no-nonsense management approaches was essential to continued process safety improvement.

Our Division has drawn heavily upon the work of the CCPS. Our scope includes human factors and others overlooked elsewhere and that is what takes it the next step and makes this the most comprehensive approach yet developed. Although the roots are in chemical process safety and for facilities handling hazardous materials, the discipline is more broadly applicable to the optimization of risks, through crisply focused management discipline, particularly when it is reinforced with a professional background in chemical engineering.

In the United States, United Kingdom and other G-20 countries, chemical engineering societies provide the organizational infrastructure and leadership to promote and advance Process Safety Management because chemical engineering, applied chemistry and chemical technology are the primary professions that apply those tools, services and techniques to manage the risks.

The third edition of our CSChE 's 26-page "Process Safety Management" guide was published in 2002. The core content was inherited from MIACC and is under ongoing review and improvement. It is available on our Web Site: <http://www.CSChE.Ca>.

When you have your appetite wetted for more insight into the applications of process safety and loss management, take a look at the bibliography in the Guide as well as the web sites of some of our brother organizations. These include the American Institute of Chemical Engineers, the Institution of Chemical Engineers and the European Federation of Chemical Engineering.

## Conclusion

The principal consumers of bulk and potentially hazardous chemicals in our industry, kraft and CTMP operations, have largely eliminated the use of gaseous chlorine and substantially reduced the consumption of gaseous sulphur dioxide. However, the potential value of the PSM discipline remains. I strongly recommend it as a solid disciplined basis for merging chemical engineering professional approaches with focused management discipline for more effective management, not only of process safety, but also other broader loss exposures in the process industries.

While I was Chairman of the CPPA Technical Section's Alkaline Pulping Committee, I served as Co-ordinator for the 1987 kraft pulp manufacturing course. The theme of my kick-off presentation was that although leading-edge technical development is key to further competitiveness advances in our industry, the real shortfall between what we already know and what we regularly achieve lies in the execution by the people who have to make it happen. Sixteen years later, it is really gratifying to be associated with a group of professionals dedicated to that same core concept: a disciplined and focused approach to doing things right, applying technically-based solid management principles, across the spectrum of process industries.

I am sure you will find the structured and disciplined approach to improving equipment reliability and process performance will enhance your level of customer service, environmental impact, cost competitiveness and of course safety and the level of trust of all stakeholders. We all gain, as professionals, as citizens and as human beings, when we can make the operational facilities where we work and the communities where we live safer for everyone.

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### Biographical Information on the Writer

Tom Boughner, General Manager, Mackenzie Operations of Pope & Talbot Ltd. in Mackenzie, British Columbia received a B. A. Sc. degree in Chemical Engineering from the University of Waterloo in 1970 and is a registered Professional Engineer in British Columbia and Ontario. He has over 30 years of experience applying his professional chemical engineering talents in technical, operations, and project management experience in pulp and paper mills in Ontario, New Brunswick and British Columbia. His diverse career spans roles with ever-increasing levels of responsibility, from Process Engineer and Production Area Supervisor through Maintenance & Engineering Manager, Pulp Production Manager, Paper Production Manager, Capital Projects Manager and, for the past dozen years, at the General Manager level.

He has senior-level mill management background in kraft pulp manufacturing and in stone groundwood specialty paper production. In April 1999, he assumed his present position in which he is responsible for all operational aspects of the Mackenzie 220,000 ADt/yr bleached kraft market pulp mill manufacturing both premium NBSK and also specialty sawdust pulp. He is a member of several pulp and paper industry technical associations, including PaPTAC, since 1970, and also the Canadian Society for Chemical Engineering which he serves as the senior pulp and paper industry representative on the Process Safety Management Division.