Wood Pellet and Bioenergy Safety Summit

TAKING SAFETY TO THE NEXT LEVEL

WOOD PELLET ASSOCIATION OF CANADA

Prince George, BC
November 15 and 16, 2023

WELCOMING REMARKS

WOOD PELLET ASSOCIATION OF CANADA

Gordon Murray (WPAC)
Julie Griffiths (Shaw Renewables)
Mike Tasker (WorkSafeBC)

WOOD PELLET ASSOCIATION OF CANADA

Responsible, Renewable Clean Energy

BC Forest Safety

BBRG BIOMASS.UBC.CA

The Power of Pellets:

Innovating Our Way to a Safer, Better Product

STRONG FOUNDATIONS BUILD SAFER FUTURES: RECAPPING KEY SUCCESSES

WOOD PELLET ASSOCIATION OF CANADA

Gordon Murray
WPAC

WPAC SAFETY COMMITTEE

- Established in 2014.
- Initial focus on combustible dust.
- Expanded to other occupational, health and safety matters, including lockout tagout, working at heights, and confined spaces.
- Expanded further into process safety.
- Continuously progressive safety projects that reflect and respond to the needs of the sector.

2014 -2023

WOOD PELLET ASSOCIATION OF CANADA

WPAC Safety Committee Initiatives

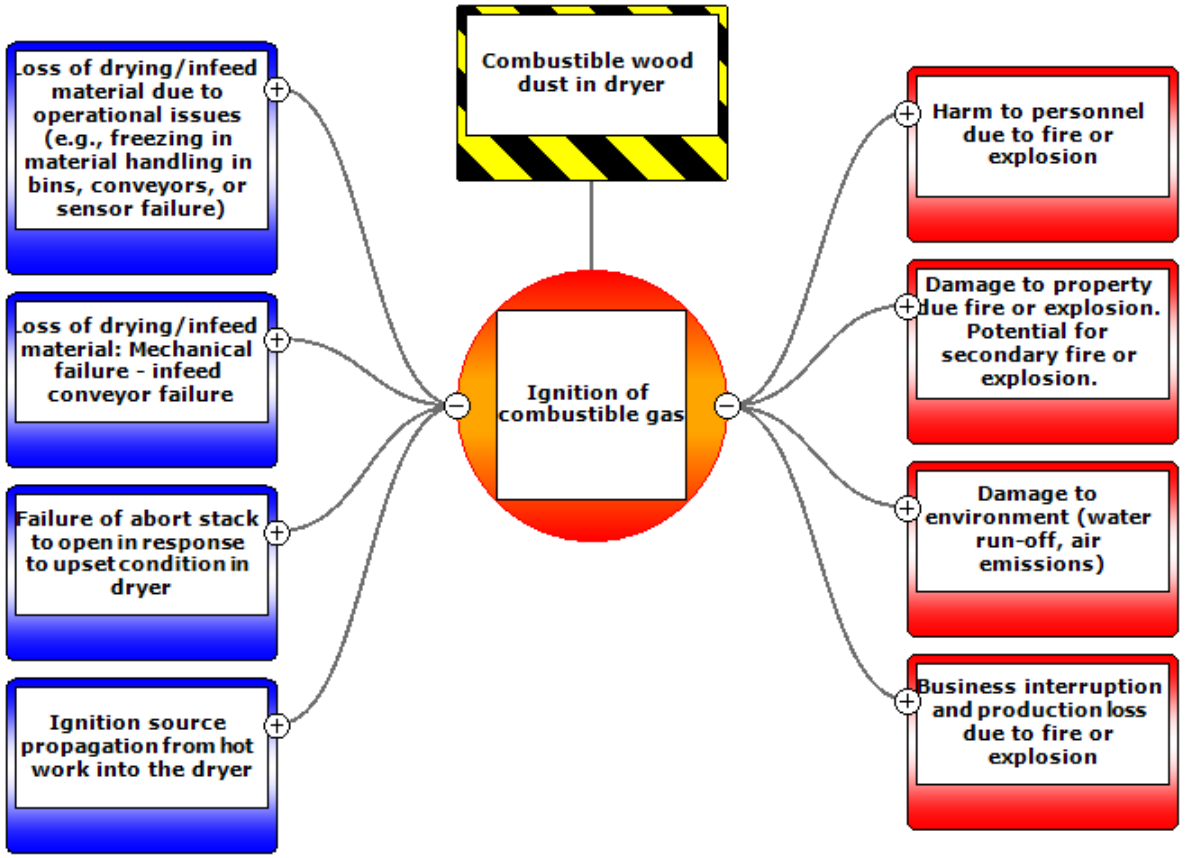
One-Stop Safety Resource

PROJECTS 2020-2023

- Critical control management
- Inherently safer design
- Belt dryer working group
- Deflagration isolation
- Combustible gas
- Operator training program and online learning platform

CRITICAL CONTROL MANAGEMENT (CCM)

- Key outcomes:
  - Improved understanding of operational hazards and ensuring effectiveness of safeguards.
  - Bow tie analyses developed for most plant processes (e.g., dryer, hammer mill, baghouse).



Credit: Obex Risk, WPAC, BCFSC, Premium Pellet Ltd.

[Critical Control Management Resources]

CRITICAL CONTROL MANAGEMENT (CCM)

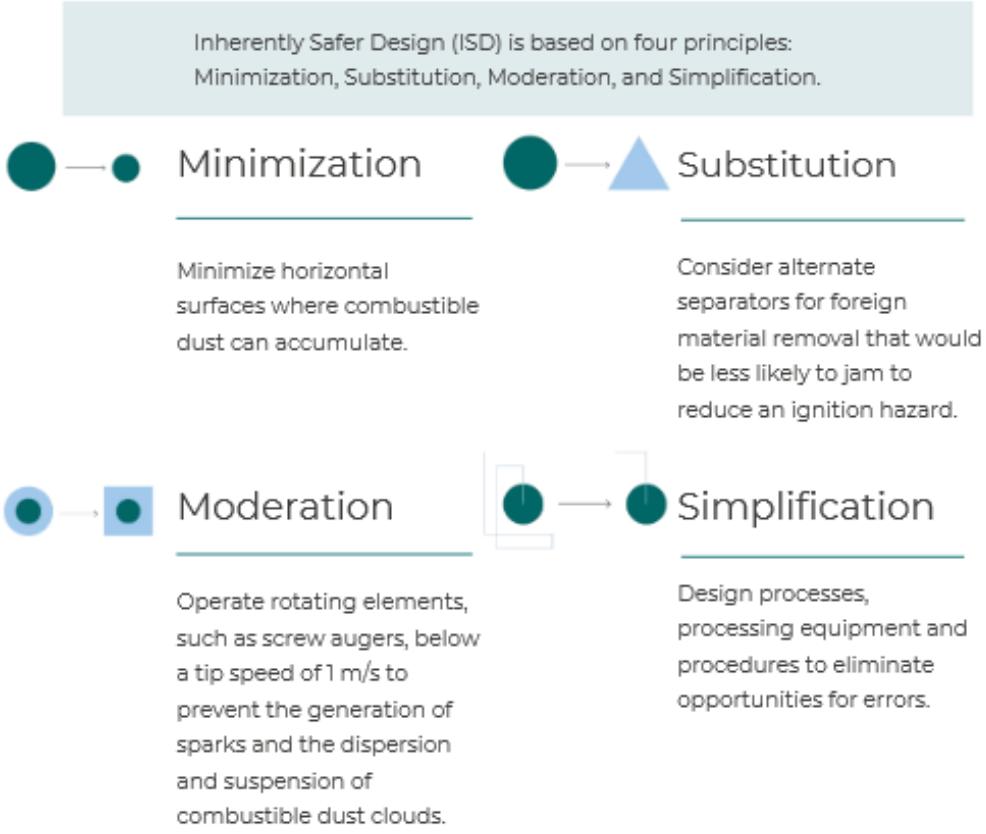
Large initiative, helped improve process safety through numerous elements:

- ✓ Senior Leadership accountability
- ✓ Operational excellence
- ✓ Management of change (MOC)
- ✓ Emergency management planning
- ✓ Process risk assessment and risk reduction
- ✓ Process and equipment integrity
- ✓ Enhancing process safety knowledge

INHERENTLY SAFER DESIGN (ISD)

- Key outcomes:
  - Examples of how ISD can be used in plants.
  - Research report, webinar, factsheet.

- Improved process safety by:
  - ✓ Process risk assessment and risk reduction
  - ✓ Enhancement of process safety knowledge

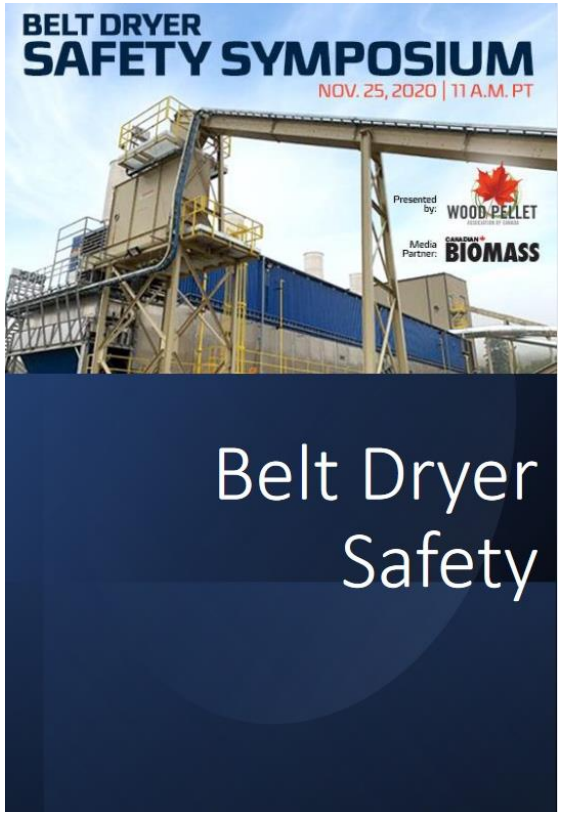


Credit: Obex Risk

Inherently Safer Design (ISD) Resources

BELT DRYER WORKING GROUP

- Key outcomes:
  - Technical recommendations for belt dryer operation.
  - Enhanced understanding of safer operation of belt dryers.
  - Report and factsheet summarizing findings.



Belt Dryer Safety Resources

BELT DRYER WORKING GROUP

- Sector-wide initiative helped improve process safety (preventing fires and explosions) and make the sector safer through:
  - ✓ Senior leadership accountability
  - ✓ Process safety culture
  - ✓ Enhancing process safety knowledge
  - ✓ Process risk assessment and risk reduction

DEFLAGRATION ISOLATION

- Key outcomes:
  - Enhanced understanding of deflagration isolation.
  - Technical recommendations for more effective isolation systems.
  - Report, webinar and factsheet summarizing findings.

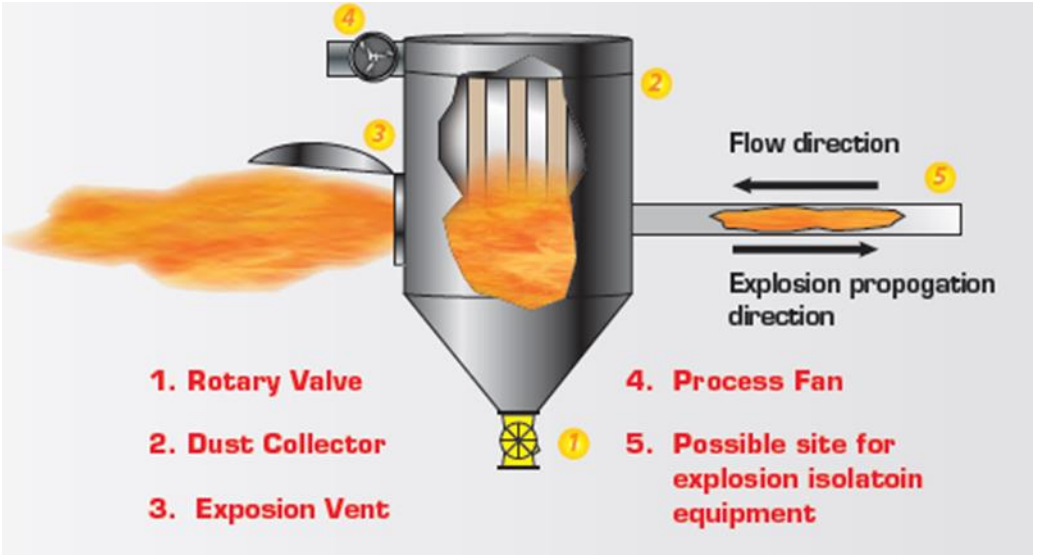


Photo Credit: CV Technology

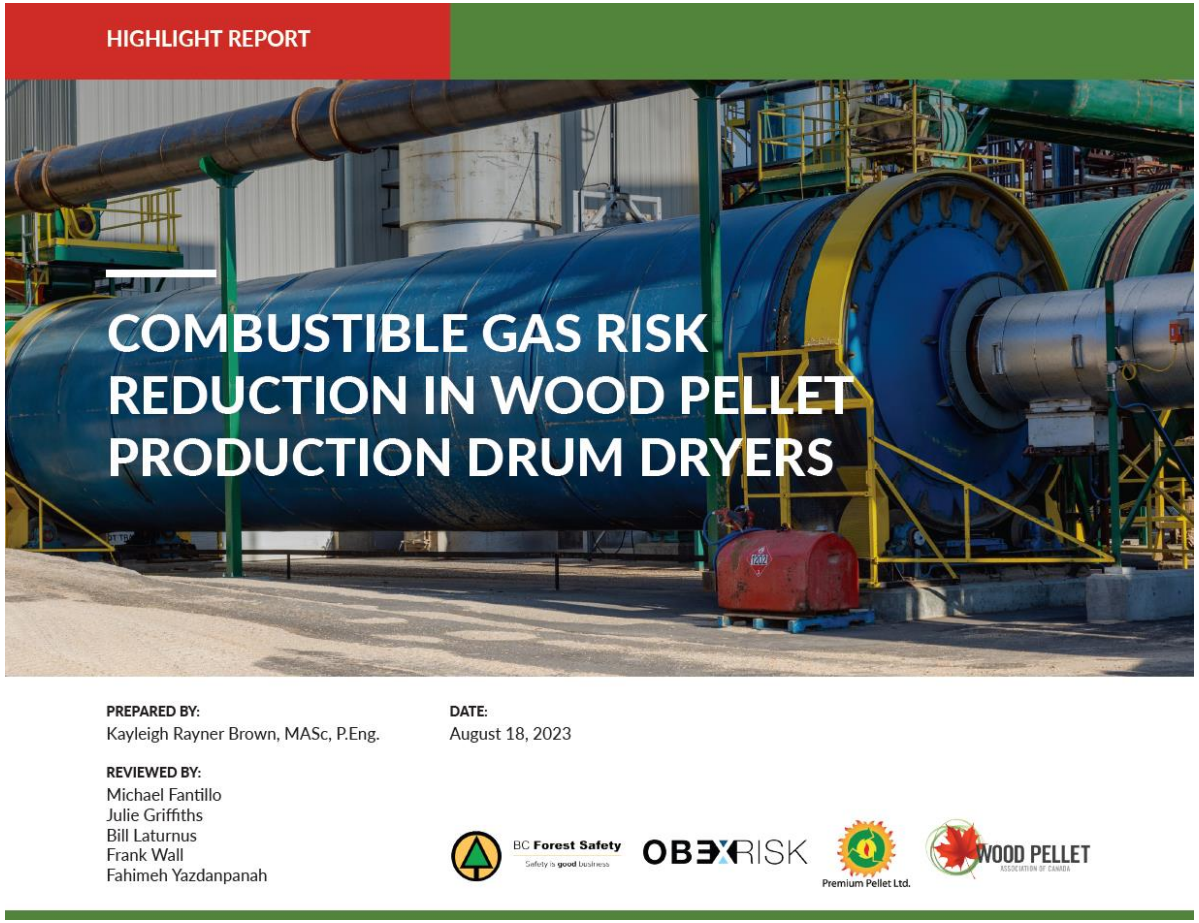
Deflagration Isolation Resources

DEFLAGRATION ISOLATION

- Improved process safety (preventing fires and explosions) by supporting:
  - ✓ Process risk assessment and risk reduction
  - ✓ Process and equipment integrity
  - ✓ Enhancing process safety knowledge
  - ✓ Regulations, codes, and standards

COMBUSTIBLE GAS

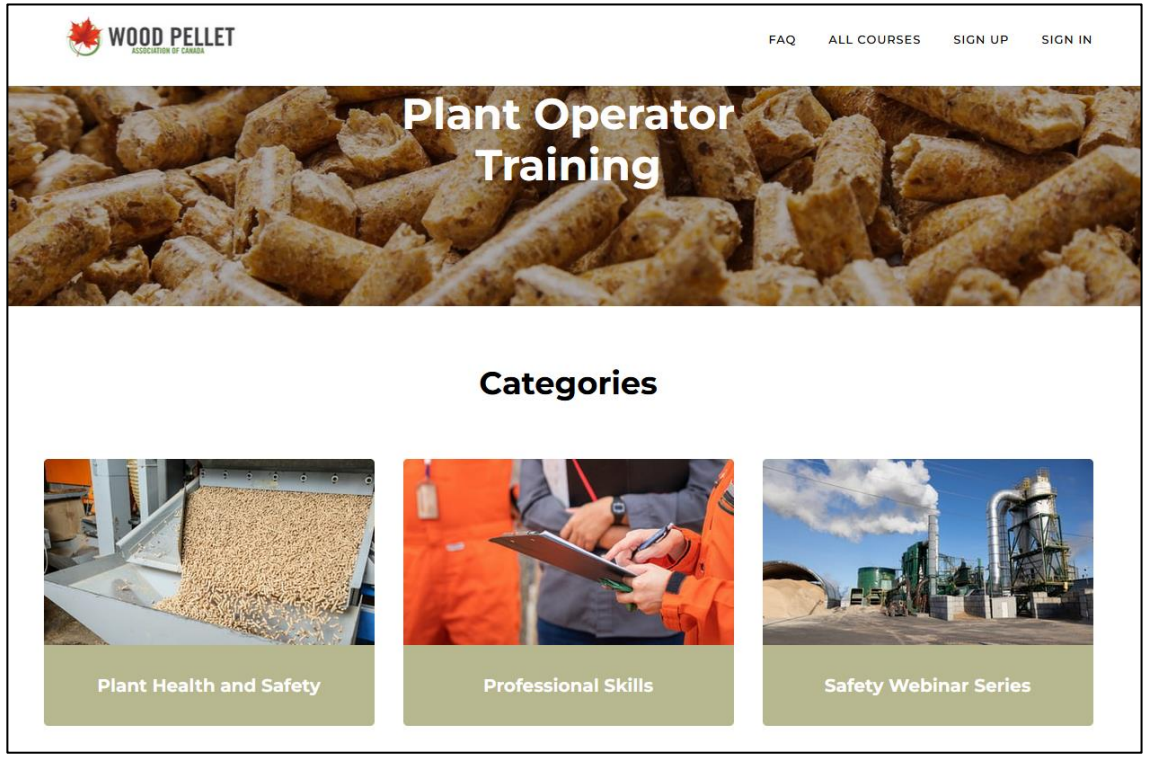
- Key outcomes:
  - Improved understanding of operational hazards and ensuring effectiveness of safeguards.
  - Summary report and factsheet with hazard analyses for normal operations, upset conditions and confined space activities.
- Improved process safety by:
  - ✓ Process risk assessment and risk reduction



Combustible Gas Resources

ONLINE OPERATOR TRAINING PROGRAM

- Key outcomes:
  - Developed by operations for operations.
  - Free state-of-the-art online learning platform with 17 modules for operators and supervisors.
  - Webinar and factsheet to onboard new learners.
- Improved process safety by:
  - ✓ Training and competency
  - ✓ Enhancing process safety knowledge



Online Operator Training Resources

BUILDING ON OUR SUCCESS

- Upcoming projects:
  - Drum Dryer Working Group
  - Mobile Equipment Hazard Analysis
  - Proposed: Process Safety Management (PSM) Implementation
  - Proposed: New Combustible Dust Regulations Self-Audit Tool and Action Plan

BUILDING ON OUR SUCCESS

Live polling and discussion

THE NEXT STEP IN SAFETY: PROCESS SAFETY MANAGEMENT

WOOD PELLET ASSOCIATION OF CANADA

Kayleigh Rayner Brown
Obex Risk

WHAT IS PSM?

- PSM is the use of management principles and systems to identify, understand, avoid, and control process hazards in order to prevent, mitigate, prepare for, respond to, and recover from process-related incidents.

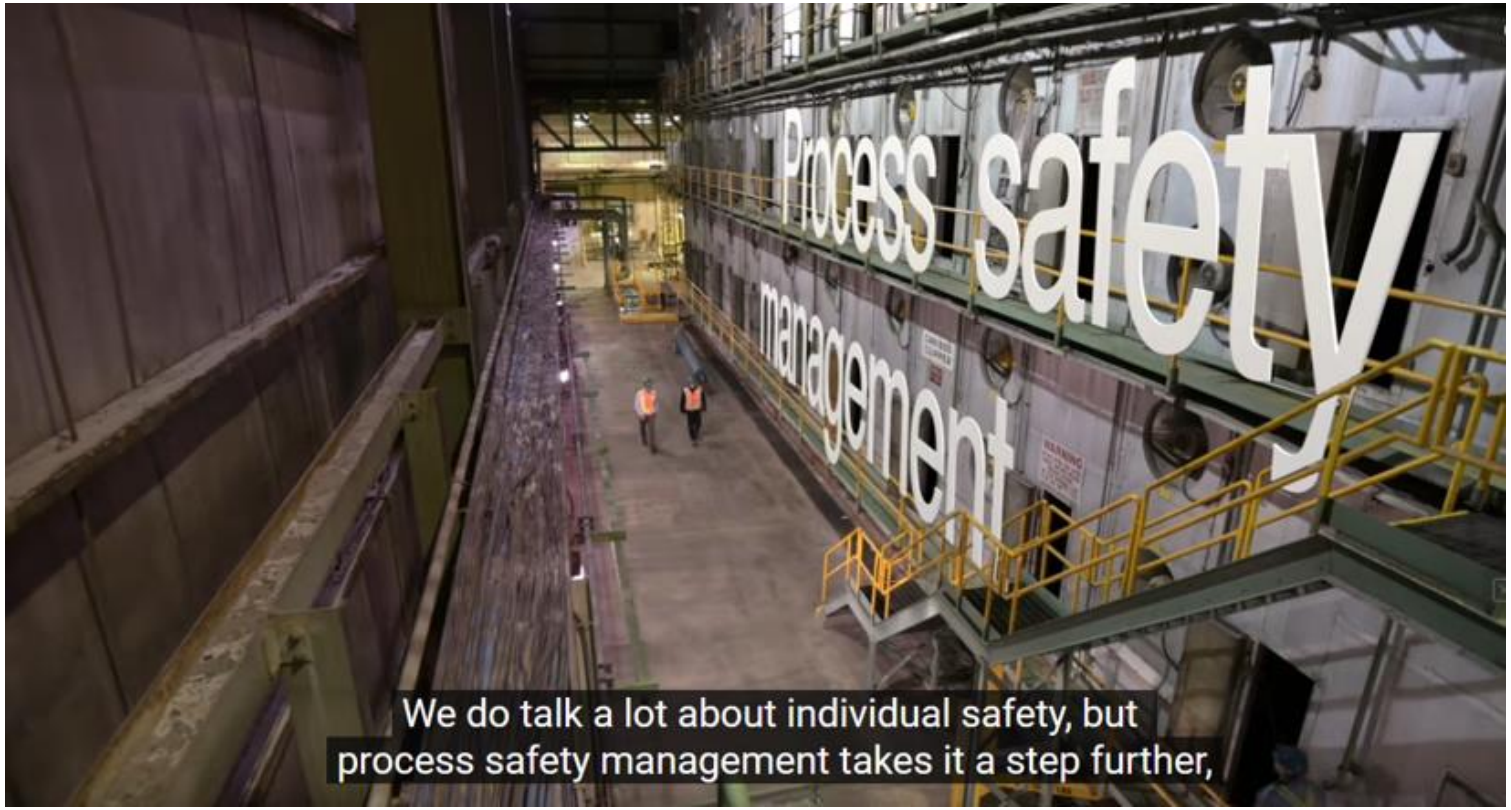
- Projects previously discussed align with *Process Safety Management (PSM)*

PROCESS SAFETY VERSUS PERSONAL SAFETY (ADAPTED FROM CSB, 2016)

	Process Safety	Personal Safety
Scope	Complex technical systems	Individual workers and injuries
Prevention	Management systems for design, mechanical integrity, hazard evaluation, management of change	Procedures, training, personal protective equipment (PPE)
Risk	Events with potential for catastrophic outcomes (injuries, fatalities, environmental, property, business interruption)	Slips, trips and falls, musculoskeletal injuries (MSI), electrocution, struck-by mobile equipment
Primary actors	Executives, engineers, managers, operations personnel	Frontline workers, supervisors, managers
Examples of leading and lagging safety indicators	Material releases, inspection frequency, PSM action closures, maintenance backlog	Recordable injury rate, days away from work, refresher training

MANAGING RISK IN HIGH-HAZARD SECTORS

Process Safety: Managing Risk in High-Hazard Sectors (WorkSafeBC)



Credit: WorkSafeBC

BUSINESS BENEFITS OF PROCESS SAFETY (CCPS, 2018)

- Corporate Social Responsibility
- Business Flexibility—companies welcomed by communities and preserve resources that could be used to focus on growth
- Loss Prevention
- Sustainable Growth
- Leadership Excellence—involved leadership and management that ensures consistency and reliability, which carries over to other business areas

EVOLUTION OF PROCESS SAFETY AND THE WOOD PRODUCTS INDUSTRY

Building on existing management system to include other elements that encompass and support process safety.

Process Safety Management Elements			
Process safety leadership	Understanding hazards and risks	Risk management	Review and improvement
Accountability	Process knowledge and documentation	Training and competency	Investigation
Regulations, codes, and standards	Project review and design procedures	Management of change	Audits process
Process safety culture	Process risk assessment and risk reduction	Process and equipment integrity	Enhancement of process safety knowledge
Conduct of operations — senior management responsibility	Human factors	Emergency management planning	Key performance indicators

CSA Z767 *Process safety management* standard framework

Credit: CSA (2017)

ACCOUNTABILITY

- Senior management's responsibility for the PSM system.
- Establishing process safety goals.
- Considering process safety risks throughout the facility lifecycle.
- Ensuring the PSM system is implemented, effective, reviewed, and improved regularly.

- *Has your company established goals and objectives related to process safety at your facility?*
- *Who is accountable for setting process safety goals, making sure they are visible and understood by relevant stakeholders, and requiring adherence to safety programs at your facility?*

REGULATIONS, CODES, STANDARDS

- Management system for the control of pertinent regulations, standards, and codes.
- Ensure relevant documentation is up to date, communicated with relevant stakeholders, and consistently used throughout the organization.

- *To the best of your knowledge, have you identified which regulations, standards, and codes apply?*
- *Is there a management system in place to trigger the development of a new company standard or procedure, or make an improvement or change to an existing one?*

PROCESS SAFETY CULTURE

- Process safety culture is the collective mindset of the organization with respect to safety and risk, including attitudes and behaviours.

- *Has process safety been formally identified as a core value at your facility?*
- *Do organizational policies include statements establishing process safety as a measure of successful operations?*
- *Are workers encouraged to raise (through supervisors or otherwise) concerns regarding deficiencies in the process safety system (e.g., failures in maintenance, safety system bypasses, and operating outside of safe operating limits)?*

CONDUCT OF OPERATIONS: SENIOR MANAGEMENT RESPONSIBILITY

- Conduct of operations refers to carrying out operational and management tasks in a methodical way to achieve excellence in operations.
- Closely tied to culture; refers to the role of senior management; responsibility for conduct of operations.

- *Have expectations been set for process safety matters (e.g., fitness for duty of personnel and equipment, personnel skills and competency, adhering to safe operating limits)?*
- *Is a strong safety culture supported through understanding primary risks, supporting programs to adhere to expectations, and seeking input to maintain awareness?*

PROCESS KNOWLEDGE AND DOCUMENTATION

- Process knowledge and documentation include process safety information, which consists of data relating to the characteristics of a process involving hazards, including hazardous materials properties, technologies and methods, equipment, and operation.
- Includes technical documentation, including piping and instrumentation diagrams (P&IDs), process flow diagrams, and process risk assessments.

- *Is plant information up-to-date and easily accessible?*

PROJECT REVIEW AND DESIGN PROCEDURES

- Project review and design procedures include the consideration of risk assessments throughout project status.
- Includes request for approval, siting decisions, and the design process.

- *Does the approval process for new projects include potential process hazards associated with the project and the project activities needed to properly manage those hazards?*

PROCESS RISK ASSESSMENT AND RISK REDUCTION

- Process risk assessment and risk reduction involve the identification and analysis of process-related hazards, documentation of hazard analyses, and implementation of risk reduction measures.

- *Has a Process Hazard Analysis (PHA) or Dust Hazard Analysis (DHA) been completed at your facility?*
- *Has an implementation plan been put in place for implementing control measures related to the risk assessment, PHA or DHA?*

HUMAN FACTORS

- Considers how the interaction of humans, technology, and organizations can affect process safety.
- Human factors evaluate human interactions with respect to other components of a workplace system with the goal of optimizing safety, human well-being and overall system performance.

- *Have you completed a human factors review to understand when human error has the potential to initiate or mitigate a large-scale event?*

TRAINING AND COMPETENCY

- Training and competency refers to the system in place to ensure that personnel have the required qualifications and competencies to fulfill their roles and responsibilities and conduct their tasks safely and effectively.
- Includes experience, education, and training.

- *Is there a training program in place to ensure all employees and contractors possess the necessary experience, education and training associated with process safety risks at the facility?*

MANAGEMENT OF CHANGE

- Management of change (MOC) refers to the formalized process to manage risks associated with changes to design, equipment, procedures, personnel, and the organization.
- Includes temporary and permanent changes.

- *Do you have a formal Management of Change Process?*
- *Does the MOC system define what constitutes a change at the facility and is covered under the program?*

PROCESS AND EQUIPMENT INTEGRITY

- Inspection, testing, and maintenance (ITM) of equipment.
- Establishing safe work practices.
- Conducting a pre-startup safety review (PSSR) before running a new or modified process or equipment.

- *Have you identified process safety critical equipment at your facility?*
- *Have you established safe work practices for alarm and instrumentation management?*

EMERGENCY MANAGEMENT PLANNING

- Used to manage the consequences of hazardous scenarios that could arise from a loss of containment incident considering regulatory requirements, standards, and industry best practices in the preparation for and response to an emergency.

- *Do you have a formal Emergency Management Program and/or Emergency Response Plan?*
- *Do you conduct a full-scale emergency exercise which engages all relevant internal and external groups at least every 5 years?*

INVESTIGATION

- Investigation is the program established to identify, report, investigate, and record process safety incidents.
- Process safety incidents include near misses as well as significant events.

- *Do you have a system to identify, report, investigate and record all incidents, including near misses and abnormal events?*

AUDITS PROCESS

- Establishing an audit system to assess whether the PSM program meets the requirements in a PSM standard.
- Includes a routine review of each management system element to assess their effectiveness.

ENHANCEMENT OF PROCESS SAFETY KNOWLEDGE

- Continuous improvement through industry learnings and participation in various associations (e.g., professional, trade, labour, technical), and incorporation of advances and improvements where feasible.

KEY PERFORMANCE INDICATORS (KPIS)

- Leading indicators are process-focused metrics to provide an early signal of potential issues or degradation of safety controls so proactive corrective actions can be conducted.
- Lagging indicators are outcome-focused metrics that can signify recurring issues and include events that have taken place.
- Consider KPIs that:
  - Refer to process safety critical equipment and items that influence system performance.
  - Advance process safety performance improvement and learning.
  - Can be used for benchmarking.

PSM RESOURCES

PSM RESOURCES

PROCESS SAFETY MANAGEMENT: SUMMARY AND RESOURCES

Around the world, process safety management (PSM) is becoming central to worker safety and managing risk. PSM implementation protects personnel, equipment, and production uptime, and is associated with lower maintenance cost, insurance and capital.

The Wood Pellet Association of Canada (WPAC), BC Forest Safety Council (BSFSC), Dalhousie University, and DustEx Research Ltd., along with Obex Risk Ltd. as project technical lead, recently completed a research project to look at the implementation of PSM using the CSA Z767 Process Safety Management standard as the framework.

The recommendation from *Integrating Process Safety Management into Canadian Wood Pellet Facilities that Generate Combustible Wood Dust* is that the industry proceed with PSM implementation through a strategic long-term plan. It is anticipated this initiative will be a core focus of the WPAC Safety Committee Workplan for the next 5-7 years.

This summary of current resources has been developed to help support wood pellet operations implement PSM.

OVERVIEW OF PSM FRAMEWORK

CSA Z767 is a Canadian standard applicable to a Canada-based project and provides the opportunity to consider industry best practices based on the practices and standards developed by experts in a wide range of high-hazard industries.

PROCESS SAFETY MANAGEMENT ELEMENTS			
PROCESS SAFETY LEADERSHIP	**UNDERSTANDING HAZARDS AND RISKS**	**RISK MANAGEMENT**	**REVIEW AND IMPROVEMENT**
Accountability	Process knowledge and documentation	Training and competency	Investigation
Regulations, codes, and standards	Project review and design procedures	Management of change	Audits process
Process safety culture	Process risk assessment and risk reduction	Process and equipment integrity	Enhancement of process safety knowledge
Conduct of operations — senior management responsibility	Human factors	Emergency management planning	Key performance indicators

BC Forest Safety Safety is good business · OBEXRISK · DALHOUSIE UNIVERSITY · DUST SAFETY SCIENCE · WOOD PELLET ASSOCIATION OF CANADA

WOOD PELLET ASSOCIATION OF CANADA

FAQ ALL COURSES SIGN UP SIGN IN

Process Safety Management

What you will learn about in this course includes:

- Process safety
- Process safety management
- Elements of process safety
- Bow tie analysis, critical controls and critical control management

WPAC PSM training module (www.wpaclearning.com)

WOOD PELLET ASSOCIATION OF CANADA

ABOUT RESOURCES NEWS EVENTS SAFETY MEMBERS

PELLETS + OUR PLANET PELLETS + BIOECONOMY PELLETS + YOUR HOME PELLETS + BUSINESS

Home > Safety > Safety Initiatives > Process Safety Management (PSM)

Process Safety Management (PSM)

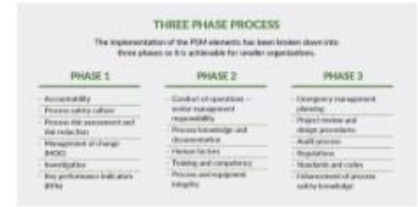
Around the world, process safety management (PSM) is becoming central to worker safety and managing risk. PSM implementation protects personnel, equipment, and production uptime, and is associated with lower maintenance cost, insurance and capital.

The industry will implement PSM through a strategic long-term plan, using the CSA Z767 Process Safety Management standard as the framework. It is anticipated the initiative will be a core focus of the WPAC Safety Committee Workplan until 2028-2030. Return to this page often for updated information.

Process Safety Management Elements

PSM Implementation Strategy

PSM implementation continues our sector's commitment to constant improvement and sharing learning. Safety experts will do most of the hands-on work and will be guided by a steering committee.



Resources

Read report: Integrating Process Safety Management into Canadian Wood Pellet Facilities that Generate Combustible Wood Dust

Read fact sheet: PSM Overview

Read fact sheet: PSM Summary and Resources

View presentation: PSM Implementation: Research Outcomes and Next Steps

Utilize fact sheets and self-assessment work sheets: On key PSM elements:

- Accountability
- Key Performance Indicators (KPIs)
- Management of Change (MOC)
- Process Safety Culture

This project was funded by WorkSafeBC under an Innovation at Work grant. The views, findings, opinions, and conclusions expressed herein do not represent the views of WorkSafeBC.

DIVE DEEPER

REPORT
Integrating Process Safety Management into Canadian Wood Pellet Facilities that Generate Combustible Wood Dust

FACT SHEET
Process Safety Management: Overview

FACT SHEET
Process Safety Management: Summary and Resources

WEBINAR
PSM Implementation: Research Outcomes and Next Steps

FACT SHEET
Process Safety Management: Accountability

FACT SHEET
Process Safety Management: Key Performance Indicators

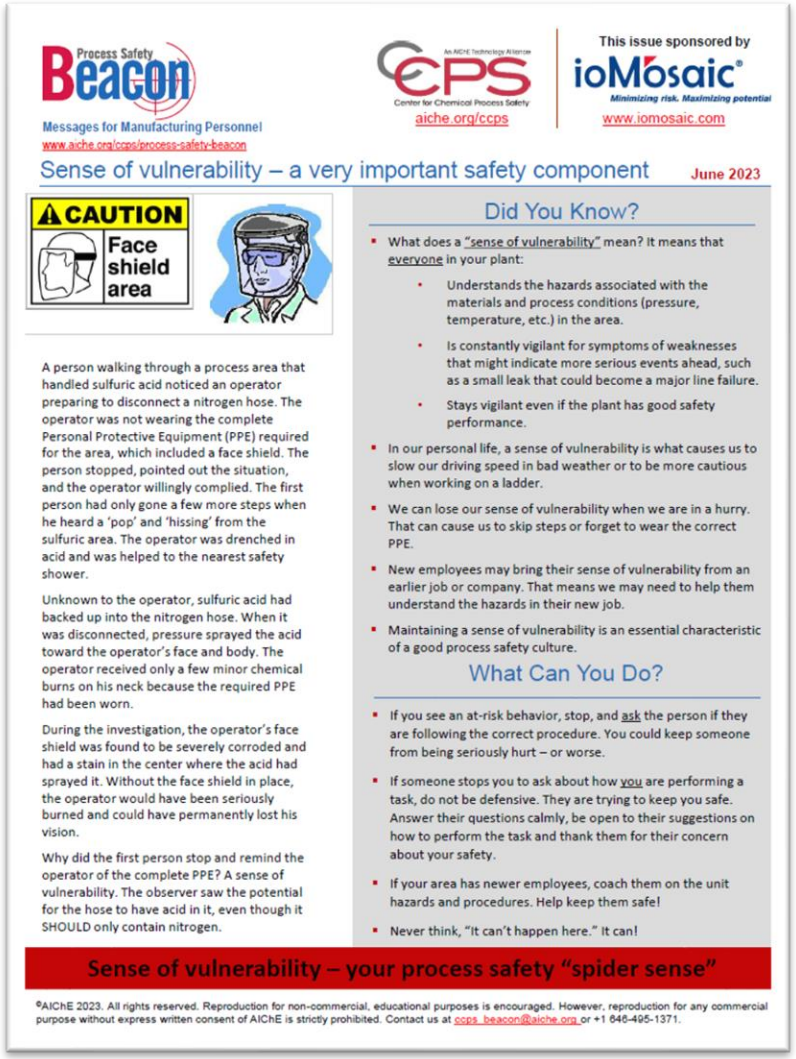
FACT SHEET
Process Safety Management: Management of Change

FACT SHEET
Process Safety Management: Process Safety Culture

New PSM page on pellet.org

PSM RESOURCES

Introduction to Process Safety Resources
Center for Chemical Process Safety (CCPS) Process Safety Beacon
Energy Safety Canada (2019). An Introduction to Process Safety
Occupational Safety and Health Administration (OSHA) (2017). Process Safety Management for Small Businesses
WorkSafeBC (2020). Process Safety: Managing Risk in High-Hazard Sectors



Process Safety Beacon

Messages for Manufacturing Personnel

www.aiche.org/ccps/process-safety-beacon

CCPS Center for Chemical Process Safety

aiche.org/ccps

This issue sponsored by ioMosaic

Minimizing risk. Maximizing potential

www.iomosaic.com

Sense of vulnerability – a very important safety component

June 2023

CAUTION Face shield area

A person walking through a process area that handled sulfuric acid noticed an operator preparing to disconnect a nitrogen hose. The operator was not wearing the complete Personal Protective Equipment (PPE) required for the area, which included a face shield. The person stopped, pointed out the situation, and the operator willingly complied. The first person had only gone a few more steps when he heard a 'pop' and 'hissing' from the sulfuric area. The operator was drenched in acid and was helped to the nearest safety shower.

Unknown to the operator, sulfuric acid had backed up into the nitrogen hose. When it was disconnected, pressure sprayed the acid toward the operator's face and body. The operator received only a few minor chemical burns on his neck because the required PPE had been worn.

During the investigation, the operator's face shield was found to be severely corroded and had a stain in the center where the acid had sprayed it. Without the face shield in place, the operator would have been seriously burned and could have permanently lost his vision.

Why did the first person stop and remind the operator of the complete PPE? A sense of vulnerability. The observer saw the potential for the hose to have acid in it, even though it SHOULD only contain nitrogen.

Did You Know?

- What does a "sense of vulnerability" mean? It means that everyone in your plant:
  - Understands the hazards associated with the materials and process conditions (pressure, temperature, etc.) in the area.
  - Is constantly vigilant for symptoms of weaknesses that might indicate more serious events ahead, such as a small leak that could become a major line failure.
  - Stays vigilant even if the plant has good safety performance.
- In our personal life, a sense of vulnerability is what causes us to slow our driving speed in bad weather or to be more cautious when working on a ladder.
- We can lose our sense of vulnerability when we are in a hurry. That can cause us to skip steps or forget to wear the correct PPE.
- New employees may bring their sense of vulnerability from an earlier job or company. That means we may need to help them understand the hazards in their new job.
- Maintaining a sense of vulnerability is an essential characteristic of a good process safety culture.

What Can You Do?

- If you see an at-risk behavior, stop, and ask the person if they are following the correct procedure. You could keep someone from being seriously hurt – or worse.
- If someone stops you to ask about how you are performing a task, do not be defensive. They are trying to keep you safe. Answer their questions calmly, be open to their suggestions on how to perform the task and thank them for their concern about your safety.
- If your area has newer employees, coach them on the unit hazards and procedures. Help keep them safe!
- Never think, "It can't happen here." It can!

Sense of vulnerability – your process safety "spider sense"

Credit: Center for Chemical Process Safety (CCPS)

THE NEXT STEP IN SAFETY: PROCESS SAFETY MANAGEMENT

Live polling and discussion

PSM RESEARCH PROJECT RESULTS

THREE PHASE PROCESS

The implementation of the PSM elements has been broken down into three phases so it is achievable for smaller organizations.

PHASE 1

- Accountability
- Process safety culture
- Process risk assessment and risk reduction
- Management of change (MOC)
- Investigation
- Key performance indicators (KPIs)

PHASE 2

- Conduct of operations — senior management responsibility
- Process knowledge and documentation
- Human factors
- Training and competency
- Process and equipment integrity

PHASE 3

- Emergency management planning
- Project review and design procedures
- Audit process
- Regulations
- Standards and codes
- Enhancement of process safety knowledge

MORNING BREAK – COFFEE AND NETWORKING

ESC OVERVIEW & PROCESS SAFETY SUPPORT FOR THE ENERGY INDUSTRY

Lucie Janosek

November 15, 2023

ENERGY SAFETY CANADA

ENERGY SAFETY CANADA

THE NATIONAL SAFETY ASSOCIATION FOR CANADA'S ENERGY INDUSTRY

ESC | TRAINING FOR INDUSTRY

ENERGY SAFETY CANADA

Training

3 million+
training certificates issued

390+
certified instructors across the nation

Accessible
in a variety of modalities: classroom, online, virtual & blended delivery

Fit-for-purpose
convenient & high-quality training

Developed
alongside industry

Accepted
across Canadian worksites

ESC | KNOWLEDGE HUB

Certificate of Recognition (COR)

The only partner offering a single streamlined audit

Access to 300+ auditors across the nation

2300+ CORs awarded

ESC | KNOWLEDGE HUB

Ready-made resources to help with everything from safety meetings to developing a safety management system

- Industry Recommended Practices
- Program Development Guidelines
- Safety Alerts
- Safety Bulletins
- Toolbox Talks
- Videos, Posters & Checklists

ESC | GLOBAL NETWORKING & COLLABORATION

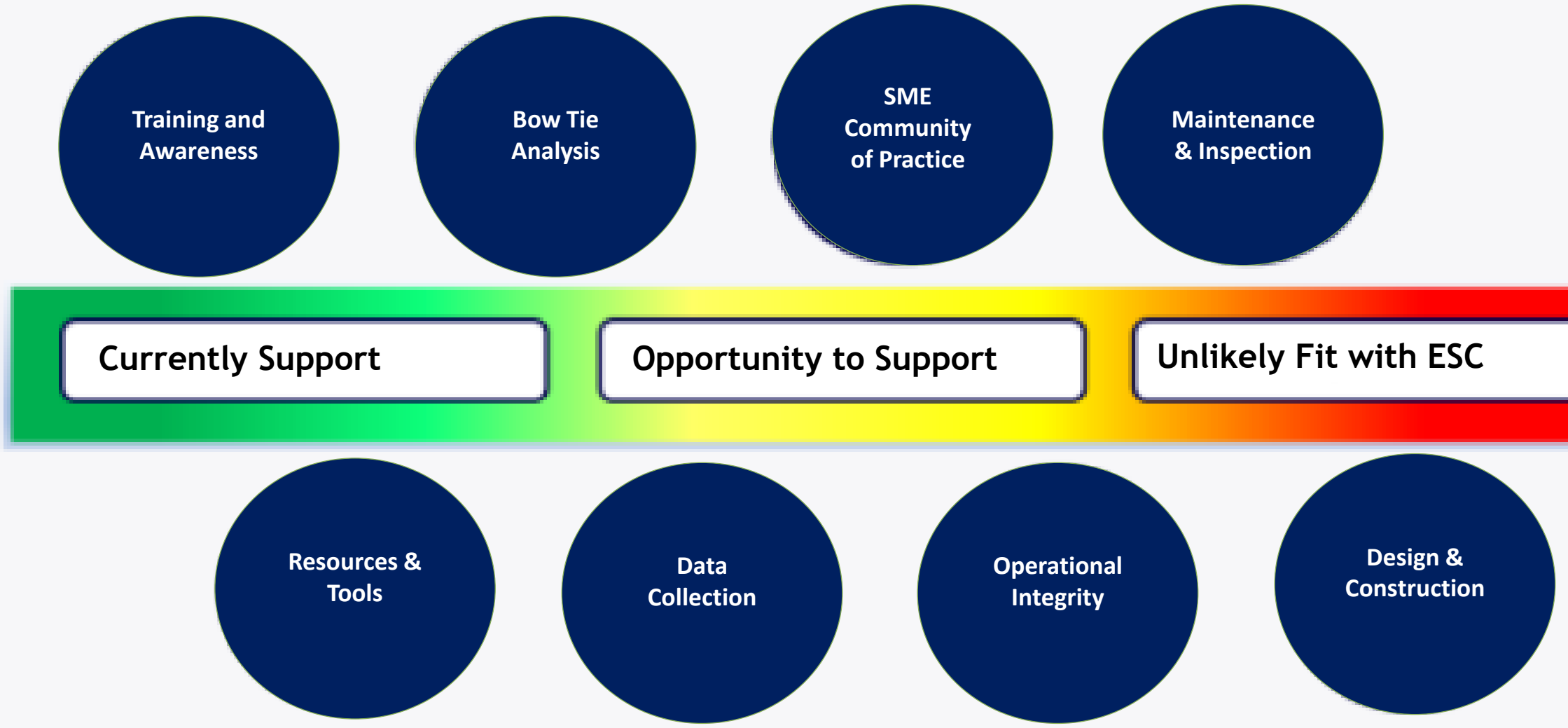
Communities of Practice is a way for industry to keep up with emerging H&S issues & share ideas

1. Pipeline
2. Get a Grip
3. Dropped Objects
4. Life Saving Rules & Potentially Serious Incidents
5. Human & Organizational Performance
6. Process Safety

ESC | PROCESS SAFETY IN THE ENERGY INDUSTRY

ENERGY SAFETY CANADA

Energy Safety Canada Process Safety Support



ESC | PROCESS SAFETY RESOURCES

ENERGY SAFETY CANADA

- Guidelines: Intro to Process Safety Guide, A Barrier Focused Approach, Measure What You Already Do
- Safety Alerts, Bulletins, and Posters
- Free Online Course
- Sector/Employer Support – Bowtie Analysis
- PSI Program and Reports
- Metrics & Event Reporting Guideline / Data Gateway
- All Process Safety Program Resources

ESC | PROCESS SAFETY COMMUNITY OF PRACTICE

ENERGY SAFETY CANADA

- Established in 2022
  - 19 companies participating
  - 7 meetings held to date

- Objectives
  - Share learnings from incidents & successful work
  - Identify synergies & opportunities for collaboration
  - Discuss & identify metrics & key performance indicators
  - Report progress and provide updates on projects and programs

ENERGY SAFETY CANADA

PRESENTATIONS

- 7 companies shared their journey in process safety
- 5 presentations:
  - Process Safety Fundamentals - Robin Gardiner
  - Pipeline System Safety Metrics - Graham Emmerson
  - Critical Controls - WorkSafeBC
  - Leadership - Richard Knowles
  - CSA Z767 – Graeme Norval and Parnian Jadidian

LEARNINGS

- HOP and Process Safety alignment
- Compliance is not enough
- Visual tools helpful - bowtie
- Keep things simple and consistent
- Recognize overlap of personal/process safety
- Operationalize process safety

ESC | CONFINED SPACE CREATIVE SENTENCING

- On November 15, 2018, near Leduc, Alberta, three workers were fatally injured (asphyxiated) from nitrogen in a confined space.

- ESC entered into an agreement with the Alberta Courts to develop three online resources related to this incident:

    1. Incident Recreation Video (Complete)
        - Includes a Bowtie and Facilitation Guide
    2. Confined Space and Asphyxiant Hazard Video Series (2024)
    3. Confined Spaces – Self-Paced Learning (2025+)

ESC | CONFINED SPACE RECREATION VIDEO

Alberta Government

ENERGY SAFETY CANADA

Thank You!

Lucie Janosek, Regional Manager, BC Operations
Lucie.Janosek@EnergySafetyCanada.com

Robert Waterhouse, Program Manager
Industry Development & Support
Robert.Waterhouse@EnergySafetyCanada.com

Process Safety is coming. Are we ready?

Wood Pellet & Biomass Safety Summit

Presented by: WorkSafeBC
Mike Tasker, CRSP Occupational Safety Officer

November 15, 2023

WorkSafeBC

Lest we forget…what brought us here.

Historical example: 2008 Imperial Sugar (Georgia)

Historical examples: 2012 (A really bad year in BC)

What is Process Safety?

- *Prevention* and/or *mitigation* of a material unwanted event (MUE)
- Focus: The sequence of events that may lead to catastrophic explosions, fires, and/or toxic releases
- Low probability, but high consequence events.

Why process safety?

- Population densification.
  - The gaps are getting smaller.
- The public demands that high risk industries maintain a safe workplace.
- Protection of people and communities.
- It’s good for business
  - Business continuity
  - Insurance costs
    - Some underwriters now requiring process safety management.

Framework for controlling process safety risks

- Formal hazard ID and risk assessment (Process Hazard Analysis)
- Identify best practice from industry knowledge, data, standards
- Use in-house knowledge and site experience of risks and controls

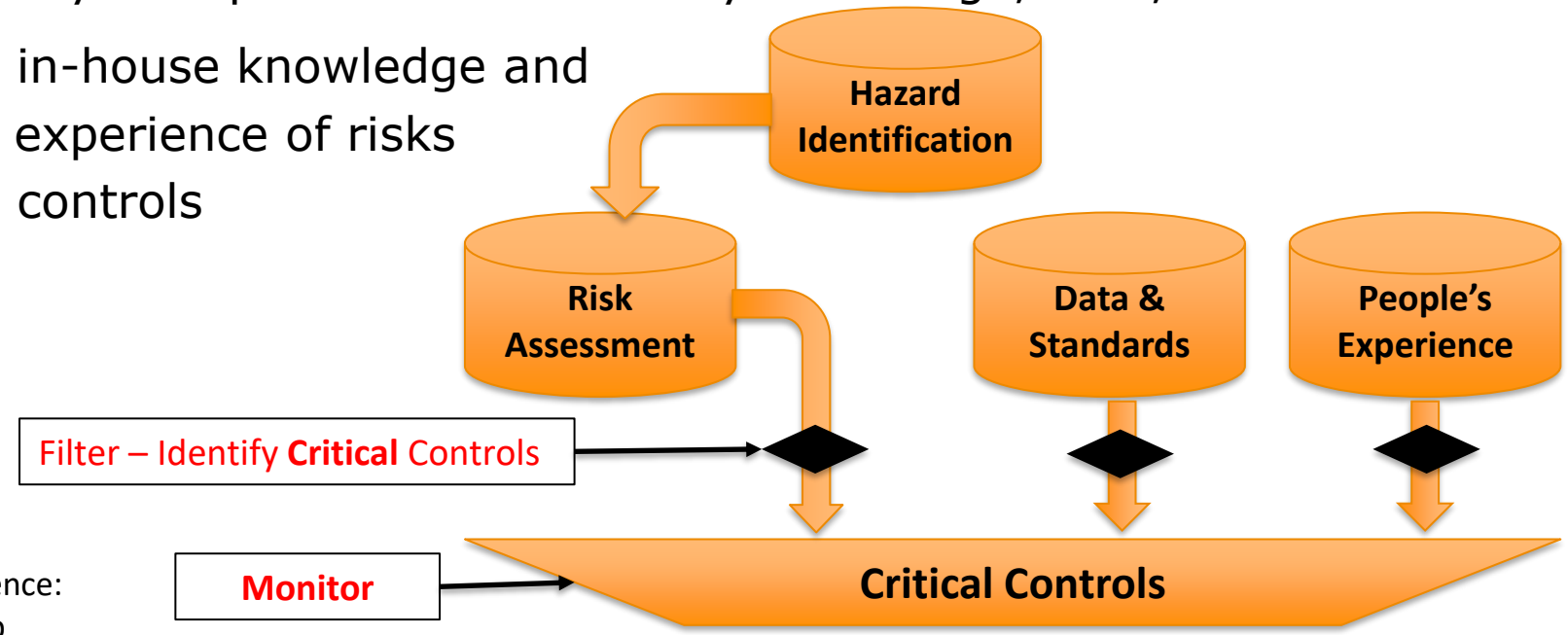
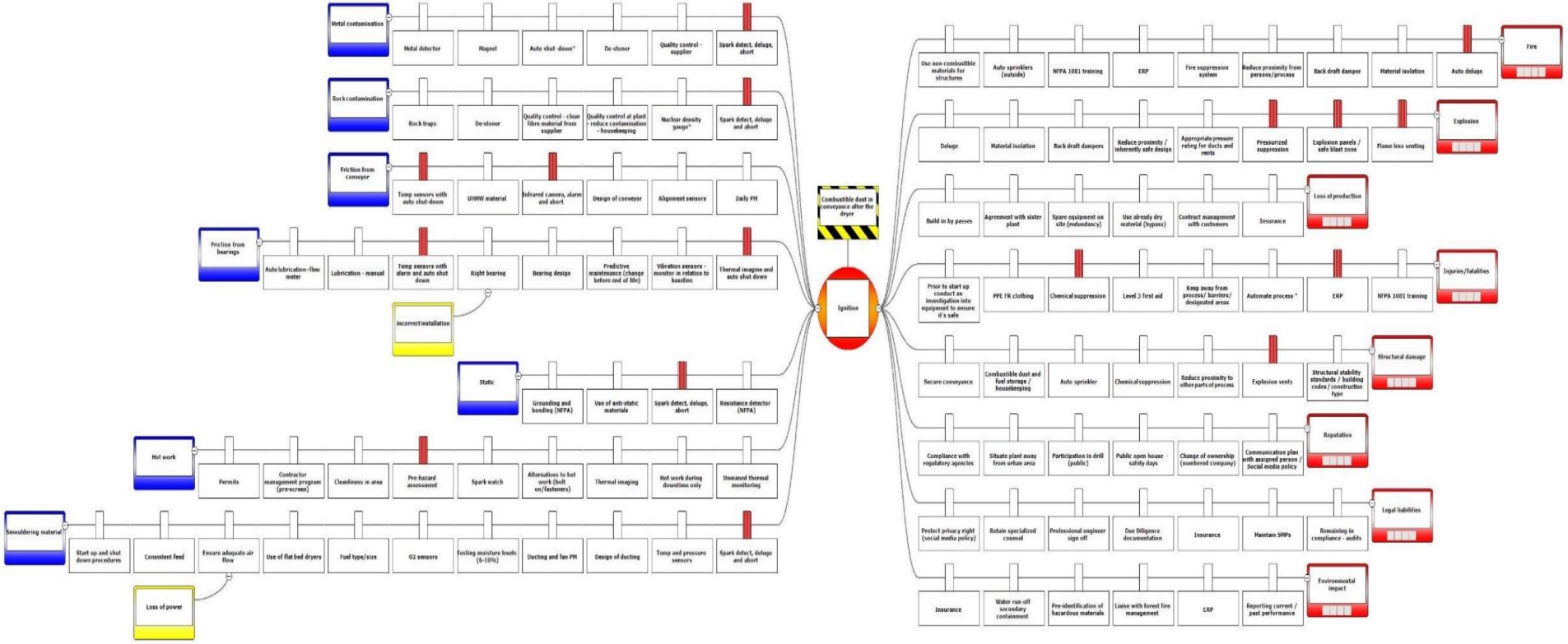
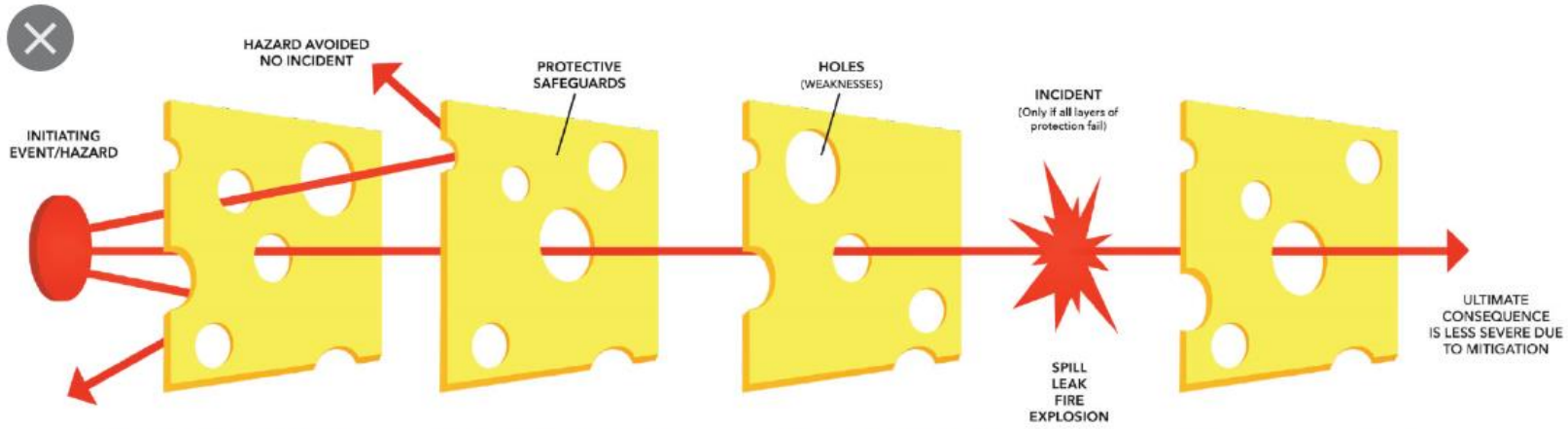


Image Reference:
Noetic Group

Completed Bowtie diagram of threats, consequences and controls



What is a Control (Barrier)?



Engineering Controls

- Safer Design
- Instrumentation in Protective Systems
- Isolation of Hazardous Energy (Lockout/ Tagout)

Administrative Controls

- Safe Lab Procedures
- Chemical Hygiene Plan
- Job Safety Analysis
- Management of Change
- Safe Work Practices

Behavioral Controls

- Use Personal Protective Equipment (PPE)
- Use the Right Tools
- Use Stop-Work Authority
- Follow Lab Procedures

Post-Incident Mitigation

- Emergency Response Plan
- Fire Suppression
- Safe Work Practices

* Adapted from the Swiss Cheese Model originally developed by James Reason

For each critical control, do you know?

- What are its general objectives?
- What are the technical performance specifications. (Set points, response times, etc.)
- Who is responsible to ensure the CC is reliable?
- What has to happen to make it work?
- How is it checked, by whom, and at what frequency?
- How are the checks verified to ensure effectiveness?
- Is there a system to document and report on the above?

What do I need to know to get started?

- Know your process. What could go wrong?
  - P&ID’s, PFD’s
- Are hazards present with catastrophic potential?
- Are you assessing your catastrophic risks.
  - (Bowties, hazop, what-if, PHA)
- How are the risks being controlled?
- How do we know we can rely on our controls?
  - Control reliability = inspection, maintenance, testing, calibration.


CRITICAL CONTROL MANAGEMENT
IMPLEMENTATION GUIDE
International Council on Mining & Metals
HEALTH AND SAFETY CRITICAL CONTROL MANAGEMENT
GOOD PRACTICE GUIDE
A Barrier Focused Approach
How to Get Started with Process Safety, Vol. 2
EDITION = 1
REVISED = January 2016
RELEASE DATE = DRAFT
CAODC
CAPP
EPAC
PSAC
ENFORM

What does the future hold?

- Focus on process safety is unlikely to go away.
- WorkSafe is beginning to broaden the scope of process safety into additional industries.
- Some regulators are adopting the CSA Z767-17 Process Safety standard.
- WorkSafeBC is considering whether specific process safety regulation is needed.

What have we learned so far?

- Generally,
  - Awareness of hazards and risks…high.
  - Effective risk control implementation…generally appropriate.
  - Control reliability…needed attention.

Think This

Not This

Wood pellet progress 2020-2023

Total submissions received and reviewed		115		
Average submissions per location		9		
Average RMP score after 1st submission /48		26/48		
Average RMP score after 5th submission /48		47/48		

Biomass power progress 2020-2023

Total submissions received and reviewed		58
Average submissions per location		11
Average RMP score after 1st submission /48		22
Average RMP score after 5th submission /48		42

Questions

LUNCH AND NETWORKING

WHAT'S OUR SAFETY CULTURE?

WOOD PELLET
ASSOCIATION OF CANADA

Julie Griffiths
Shaw Renewables

WHAT IS PROCESS SAFETY CULTURE?

- Collective mindset of organization with respect to safety and risk, including attitudes and behaviours.
- Collective practices that comprise a safety culture:
  - Reporting culture
  - Just culture
  - Learning culture
  - Flexible culture

Process Safety Management Elements			
Process safety leadership	Understanding hazards and risks	Risk management	Review and improvement
Accountability	Process knowledge and documentation	Training and competency	Investigation
Regulations, codes, and standards	Project review and design procedures	Management of change	Audits process
Process safety culture	Process risk assessment and risk reduction	Process and equipment integrity	Enhancement of process safety knowledge
Conduct of operations — senior management responsibility	Human factors	Emergency management planning	Key performance indicators

CSA Z767 *Process safety management* standard framework

Credit: CSA (2017)

REPORTING CULTURE

- People are prepared for errors, near-misses, unsafe conditions, inappropriate procedures and other concerns.

- *Are people on the lookout for things that need to be reported?*
- *Are they alert to ways that things can go wrong?*
- *Does everyone understand why, what and how to report?*
- *Does everyone know what will happen after a report is made?*

JUST CULTURE

- Considers how blame and punishment are handled.
- If blame is routine, reporting will be low.
- If blame is only placed during recklessness or defiance, reporting won't be discouraged.

- *How are the actions of workers treated when discussing near-misses and incident? Are root causes, or fault of those involved, the focus?*
- *Are workers thanks for bringing an incident forward?*
- *Are those who report consulted to help develop a solution?*

LEARNING CULTURE

- Effective reporting requires organizations to learn from these reports.

- *Is new information processed conscientiously and changes made accordingly?*
- *Are personnel continuously learning about best practices?*
- *How is the organization learning from reported incidents?*
- *Are workers encouraged to reach out about resources for additional training on specific topics of interest?*

FLEXIBLE CULTURE

- Decision-making processes will differ depending on urgency of decision and expertise of people participating.
- Decisions are made by best-suited people.

- *Does everyone take ownership of safety?*
- *Do people adapt and defer to the expertise of others?*
- *How is the collective expertise of operators, maintenance personnel, electricians, safety resources, supervisors and managers used to enhance safety-related decision-making processes?*

SAFETY CULTURE WEAKNESSES: CASE STUDIES

- Westray coal dust explosion, Hoeganaes iron flash fire (discussed in Dr. Paul Amyotte's *Introduction to Safety Culture*).
- Tesoro Anacortes Refinery (April 2, 2010): Explosion due to heat exchanger rupture; seven employee fatalities; caused by high-temperature hydrogen attack.

Photo Credit: Chemical Engineering News / US Chemical Safety Board

SAFETY CULTURE WEAKNESSES: CASE STUDIES

- Normalization of deviance (routine heat exchanger leaks).
- Poor response to issues and concerns.
- Poor sense of vulnerability (burden of proof that operation is high risk).

Photo Credit: US Chemical Safety Board

SAFETY CULTURE WEAKNESSES: CASE STUDIES

- Consequences:
  - $2.39 million fine from state (lengthy appeal).
  - $39 million settlement with families of victims.
  - Refinery shutdown for 6 months.
  - Reputation damage to refinery and industry.

Photo Credit: US Chemical Safety Board

https://www.seattletimes.com/seattle-news/tesoro-appeals-239m-fine-for-anacortes-refinery-blast/

SAFETY CULTURE WEAKNESSES: CASE STUDIES

- Williams Olefins (June 13, 2013): Equipment rupture, explosion, and fire during non-routine operational activities; two employees killed.
- Equipment isolated from protective pressure relief valve by addition of valves in 2001.

Photo Credit: US Chemical Safety Board

SAFETY CULTURE WEAKNESSES: CASE STUDIES

- Weakness in providing strong leadership and workers not empowered to successfully fulfill responsibilities.
- Deficiencies:
  - Management of change
  - Pre-startup safety review
  - Process hazard assessment actions
  - Developing and maintaining procedures
  - Uncontrolled equipment manipulations

Photo Credit: US Chemical Safety Board

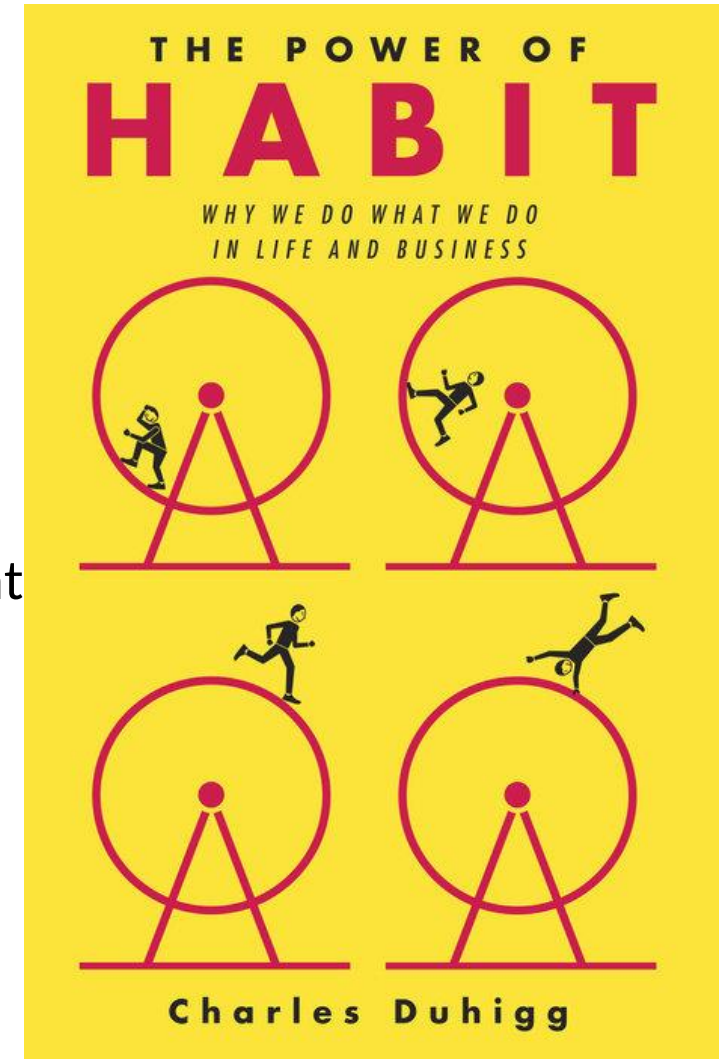
SAFETY CULTURE WEAKNESSES: CASE STUDIES

Williams Olefins Plant Explosion and Fire

Credit: US Chemical Safety Board

SAFETY CULTURE AS A DRIVER FOR IMPROVING ORGANIZATIONS – ALCOA CASE STUDY

- Aluminum company
- CEO Paul O'Neill (1987-2000): quintupled sales, increased profitability by 14%, improved productivity by 45%.
- Analyzed opportunities for improvement - involved fundamental changes in behaviour at all levels of the organization (*keystone habits*).
- Further reading: Forbes - Have We Learned The Alcoa 'Keystone Habit' Lesson?



"If you want to understand how Alcoa is doing, you need to look at our workplace safety figures. If we bring our injury rates down...it will be because the individuals at this company have...devoted themselves to creating a habit of excellence."

"Safety will be an indicator that we're making progress in changing our habits across the entire institution."

~The Power of Habit

KEY ATTRIBUTES OF A SOUND SAFETY CULTURE (CCPS, 2023)

- Champion safety as a core value.
- Provide strong leadership.
- Establish and implement high standards of performance.
- Maintain a sense of vulnerability.
- Empower individuals to effectively fulfill their safety responsibilities.
- Defer to expertise.
- Ensure open and clear communications.
- Provide a questioning/learning environment.
- Foster mutual trust.
- Deliver timely action to safety issues and concerns.
- Support continuous monitoring of performance.

Credit: CCPS (2023) https://www.aiche.org/ccps/safety-culture-what-stake

OVERCOMING SAFETY CULTURE ISSUES WITHIN YOUR ORGANIZATION

- Create awareness (highlighting connection between culture and performance, case studies demonstrating outcomes of weak safety culture).
- Identify a champion (understand safety culture dynamics, how to implement cultural change – become a student!).
- Perform a gap analysis (understand gaps and develop risk-based priorities).
- Steward cultural change (leadership serves as example, positive reinforcement and accountabilities for behaviours are required – further organization from rule-driven to value-driven).
- Keep the organization focussed (seek out and use resources to emphasize importance of safety culture).

Credit: CCPS (2023) https://www.aiche.org/ccps/safety-culture-what-stake

SAFETY CULTURE GAP ANALYSIS ACTIVITY

Complete the provided gap analysis worksheet.

Discussion:

- *What are some gaps, or opportunities for improvement, that you can identify?*
- *How would you prioritize addressing those gaps and what are some potential actions?*

Next steps:

- Review the following industry best practices and propose initiatives to undertake in your operation, or sector-wide, to help enhance process safety culture.

SAFETY CULTURE GAP ANALYSIS ACTIVITY

PSM Research Project Results

- Responses ranged greatly!
- Some respondents indicated there was open communication, shared common beliefs, and timely responses to issues.
- Other respondents indicated these attributes are not observed (numerous gaps).
- For example:
  - *How strongly is the following statement communicated and demonstrated throughout the organization: "Management and workers both hold responsibility for the role they play in preventing a process safety incident.“* Different responses: **Little** to **very strongly**

INDUSTRY BEST PRACTICES

Arendt, S. and Manton, M. (2015). How to Ensure Sustainable Process Safety Performance – Strategies for Managing, Maintaining, and Improving PSM Systems.

Center for Chemical Process Safety (CCPS) (2021). Building Process Safety Culture Tool Kit: Tools to Enhance Process Safety Performance

Contra Costa County Health Services (CCHS) (2011a). Safety Culture Survey Example: Baker Panel Report

Contra Costa County Health Services (CCHS) (2011b). Safety Culture Assessments Overview

Contra Costa County Health Services (CCHS) (2011c). Safety Culture Assessments Guidance and Example

DuPont (2010). Safety Culture Survey Example: DuPont Safety Perception Survey

Energy Institute (2023a). Hearts and Minds Safety Culture Toolkit

Resources were identified as part of the project “Integrating Process Safety Management into Canadian Wood Pellet Facilities that Generate Combustible Wood Dust” (Rayner Brown et al., 2023). This project was funded by WorkSafeBC under an Innovation at Work grant. The views, findings, opinions, and conclusions expressed herein do not represent the views of WorkSafeBC.

INDUSTRY BEST PRACTICES

HSE (2023). Organisational Culture: Guidance

HSE (n.d.). Extract from Inspectors' Human Factors Toolkit: Safety Culture Questions

Manufacturing Safety Alliance of British Columbia (MSABC) (n.d.). Safety Culture: A Guide to Effective Measurement and Improvement

Transport Canada (2021). Example Safety Culture Policy Statement

WorkSafeBC (2023b). Enhancing Health & Safety Culture & Performance

WorkSafe Queensland (2023): Safety Climate and Safety Culture Videos, Assessment Guidance, Factsheet (Safety culture, climate and leadership), Factsheet (Getting the most out of your safety climate survey)

Resources were identified as part of the project "Integrating Process Safety Management into Canadian Wood Pellet Facilities that Generate Combustible Wood Dust" (Rayner Brown et al., 2023).
This project was funded by WorkSafeBC under an Innovation at Work grant. The views, findings, opinions, and conclusions expressed herein do not represent the views of WorkSafeBC.

WHAT'S OUR SAFETY CULTURE?

Live polling and discussion

BREAKOUT SESSION: HANDLING UNCOMFORTABLE SAFETY SITUATIONS

WOOD PELLET ASSOCIATION OF CANADA

Julie Griffiths
Shaw Renewables

BREAKOUT SESSION: HANDLING UNCOMFORTABLE SAFETY SITUATIONS

Break into three groups, review your unique case study and discuss. Consider the following questions:

1. *What are some indicators of a weak safety culture in this scenario?*
2. *What are some actions and behaviours that could have reinforced a strong safety culture?*
3. *For the following, share an idea of what you would like to improve when you return to your operation:*
    a. *Reporting*
    b. *Leadership accountability*
    c. *Maintaining a sense of vulnerability and having a questioning attitude*
    d. *Safety communication (including management of change)*

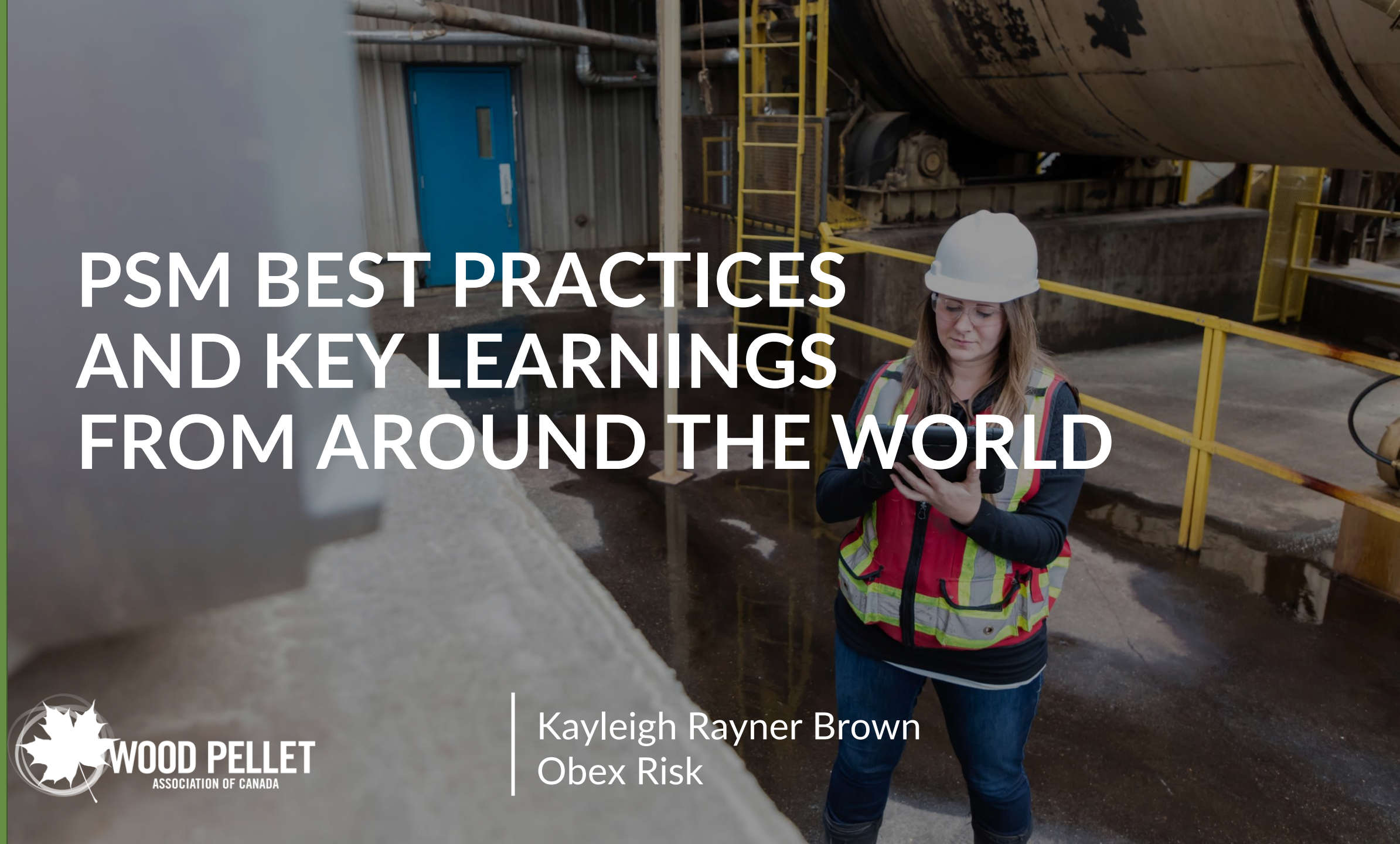
BREAKOUT SESSION: HANDLING UNCOMFORTABLE SAFETY SITUATIONS

Example:

A maintenance worker at a plant was using a hand-held temperature gun to check bearing temperatures. The device showed an error code, so the maintenance personnel reset the machine and initiated another scan; this occurred over 10 times. An electrician was passing by, who suggested using another device, as well as reporting the malfunction. The worker stated that they were reluctant to complain about the malfunctions since complaints sometimes led to work hours being reduced, so they usually made their own decisions about what to do.

Adapted from International Atomic Energy Agency (IAEA) *"Radiation Safety Culture Trait Talks"*

AFTERNOON BREAK – COFFEE AND NETWORKING



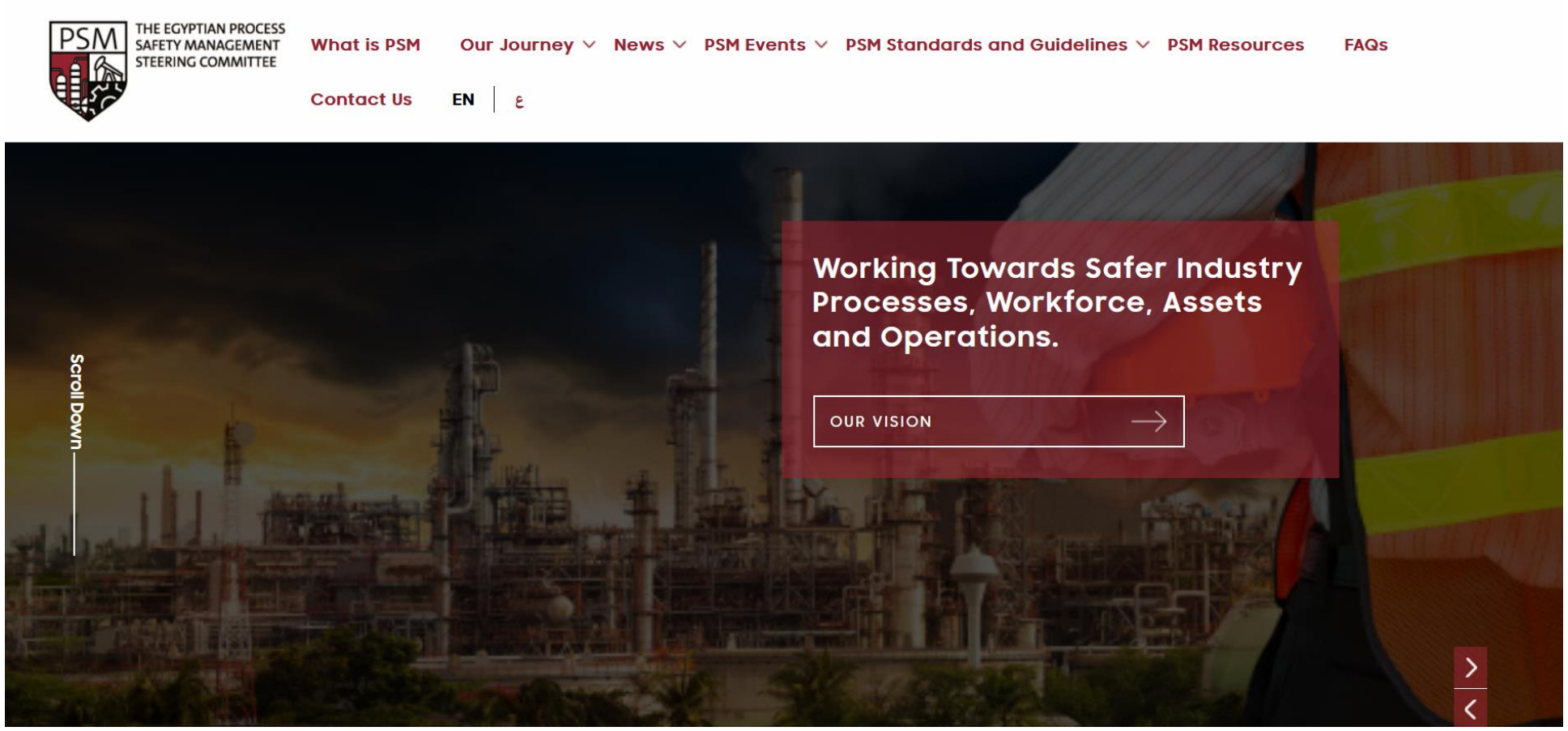
PSM BEST PRACTICES AND KEY LEARNINGS FROM AROUND THE WORLD

WOOD PELLET ASSOCIATION OF CANADA

Kayleigh Rayner Brown
Obex Risk

PSM: SECTOR-WIDE IMPLEMENTATION

Sector-Wide PSM Implementation (Oil and Gas)



PSM STEERING COMMITTEE

PSM Steering Committee

PSM Standards & Guidelines

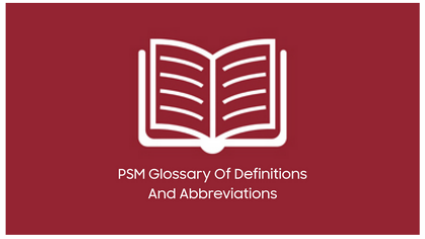
The destination to the process safety management regulations and procedures approved and issued by the Ministry of Petroleum and Mineral Resources in Egypt.

Risk Management Standard

- Approved Sheet | Approved Document

PSM Glossary Of Definitions And Abbreviations

- Approved Document



Corporate Risk Matrix

- Approved Document

Process Safety Studies In Oil & Gas Major Projects Guideline

- Approved Document

Hazard And Operability (HAZOP) Guideline

- Approved Document | Approved Sheet

Major Accident Hazard (MAH) Management

- Approved Document

PSM Program Standard

- Approved Document

Quantitative Risk Assessment (QRA) Guideline

- Approved Document

PSM: IMPLEMENTATION GUIDE

[Technical Standards and Safety Authority (TSSA) PSM Implementation Guide (Operating Engineers Safety Program)]

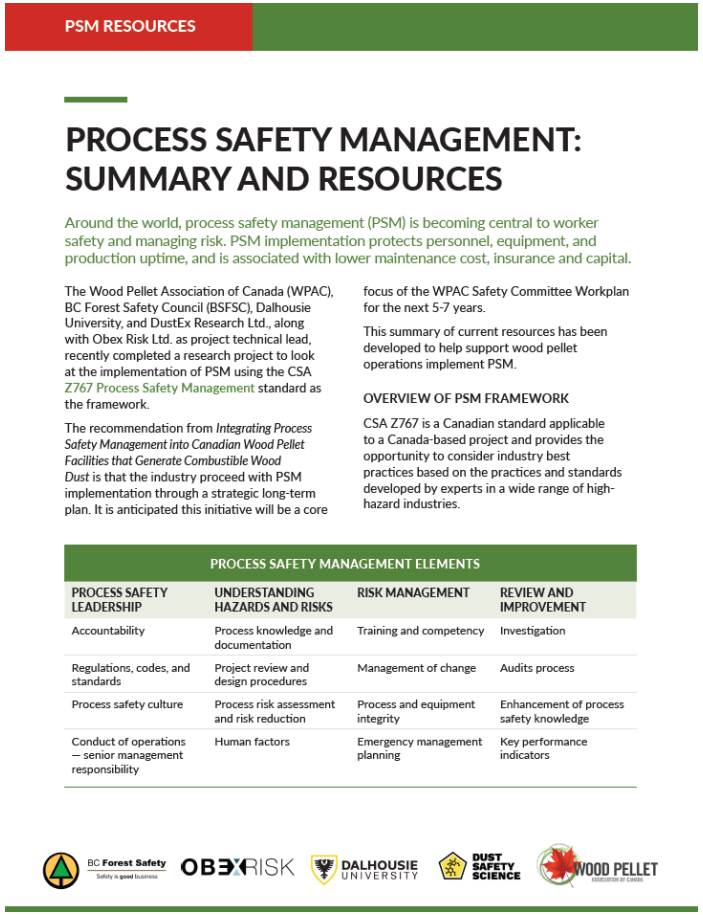
PSM IMPLEMENTATION GUIDELINES & DOCUMENTATION

PSM Implementation Guidelines and Documentation
BC Energy Regulator (BCER). (2022). Adoption of CSA Z767 in BC Regulation. 2022 Canadian Society for Chemical Engineering (CSChE) PSM Symposium.
Gulf Petrochemicals & Chemicals Association (GPCA) (2011). Process Safety Code: Process Risk Management.
HNI Risk Advisors (n.d.). Process Safety Management Plan.
Newington Energy LLC (2007). Risk Management Plan (RMP) & Process Safety Management (PSM) Manual.
Nevada Division of Environmental Protection NDEP (2023). Chemical Accident Prevention Program (CAPP) Guidance.
Penn State (2023). Process Safety Management Requirements/Guidelines.
Penn State (2016). PSM Steering Committee Charter
PSM Egypt (2022). PSM Implementation Guidelines.
PSM Egypt (2023). PSM Steering Committee
Rio Tinto (2021). Rio Tinto Process Safety Standard
Technical Standards and Safety Authority (TSSA) (2020). Path 2 Risk and Safety Management Plan (RSMP) Implementation Guide

Resources were identified as part of the project "Integrating Process Safety Management into Canadian Wood Pellet Facilities that Generate Combustible Wood Dust" (Rayner Brown et al., 2023). This project was funded by WorkSafeBC under an Innovation at Work grant. The views, findings, opinions, and conclusions expressed herein do not represent the views of WorkSafeBC.

PSM: SUMMARY AND RESOURCES

- Best practices and documents collected for each PSM element
- All links can be found in PSM Summary Report



PSM RESOURCES

PROCESS SAFETY MANAGEMENT: SUMMARY AND RESOURCES

Around the world, process safety management (PSM) is becoming central to worker safety and managing risk. PSM implementation protects personnel, equipment, and production uptime, and is associated with lower maintenance cost, insurance and capital.

The Wood Pellet Association of Canada (WPAC), BC Forest Safety Council (BSFSC), Dalhousie University, and DustEx Research Ltd., along with Obex Risk Ltd. as project technical lead, recently completed a research project to look at the implementation of PSM using the CSA Z767 Process Safety Management standard as the framework.

The recommendation from *Integrating Process Safety Management into Canadian Wood Pellet Facilities that Generate Combustible Wood Dust* is that the industry proceed with PSM implementation through a strategic long-term plan. It is anticipated this initiative will be a core focus of the WPAC Safety Committee Workplan for the next 5-7 years.

This summary of current resources has been developed to help support wood pellet operations implement PSM.

OVERVIEW OF PSM FRAMEWORK

CSA Z767 is a Canadian standard applicable to a Canada-based project and provides the opportunity to consider industry best practices based on the practices and standards developed by experts in a wide range of high-hazard industries.

PROCESS SAFETY MANAGEMENT ELEMENTS			
PROCESS SAFETY LEADERSHIP	UNDERSTANDING HAZARDS AND RISKS	RISK MANAGEMENT	REVIEW AND IMPROVEMENT
Accountability	Process knowledge and documentation	Training and competency	Investigation
Regulations, codes, and standards	Project review and design procedures	Management of change	Audits process
Process safety culture	Process risk assessment and risk reduction	Process and equipment integrity	Enhancement of process safety knowledge
Conduct of operations — senior management responsibility	Human factors	Emergency management planning	Key performance indicators

PSM BEST PRACTICES AND KEY LEARNINGS FROM AROUND THE WORLD

Resources and Best Practices for *Enhancing PSM Knowledge*
Conoco Philips (2023). Process Safety - Process Safety Summit
DustEx Research Ltd. (2023). Combustible Dust Incident Database and Reports
Energy Institute (2023). Toolbox Webinar Series (including Learning from Incidents, The Role of Leadership in Accident Investigations, Learning from What Goes Right and others listed)
Gulf Petrochemicals and Chemicals Association GPCA (2011). Process Safety Code: Process Risk Management – Enhancing Process Safety Knowledge
International Association of Oil and Gas Producers (2020). Process Safety Fundamentals
Suncor (2011). Distribution Contractor Process Safety Awareness

All links believed to be active as of November 1, 2023 – reach out to WPAC if you need assistance.

Resources were identified as part of the project "Integrating Process Safety Management into Canadian Wood Pellet Facilities that Generate Combustible Wood Dust" (Rayner Brown et al., 2023). This project was funded by WorkSafeBC under an Innovation at Work grant. The views, findings, opinions, and conclusions expressed herein do not represent the views of WorkSafeBC.

WHAT PSM LOOKS LIKE FOR CANADA'S PELLET SECTOR & NEXT STEPS

WOOD PELLET
ASSOCIATION OF CANADA

Kayleigh Rayner Brown
Obex Risk

PSM RESEARCH PROJECT RESULTS

THREE PHASE PROCESS

The implementation of the PSM elements has been broken down into three phases so it is achievable for smaller organizations.

PHASE 1

- Accountability
- Process safety culture
- Process risk assessment and risk reduction
- Management of change (MOC)
- Investigation
- Key performance indicators (KPIs)

PHASE 2

- Conduct of operations — senior management responsibility
- Process knowledge and documentation
- Human factors
- Training and competency
- Process and equipment integrity

PHASE 3

- Emergency management planning
- Project review and design procedures
- Audit process
- Regulations
- Standards and codes
- Enhancement of process safety knowledge

WHERE WE ARE AT NOW

- We have a foundation to improve the integration of process safety in operations.
- Understanding of how existing PSM frameworks (e.g., CSA Z767) can be used to meet the needs of the wood products manufacturing industry.
- A broad culture shift in the industry is being observed through the continued support of progressive process safety initiatives.
- Process safety is being embraced by other process industries.

PSM RESEARCH PROJECT OUTCOMES

Communicate and evaluate research outcomes; provide recommendations and gain consensus from stakeholders on the next actions.

Establish PSM Steering Committee, who will provide input on workplans, timelines and material and process development.

Develop process to provide ongoing support across the industry.

Develop implementation guide, workplan and milestones.

Develop self-assessment worksheets for each of the PSM elements.

Develop additional resources with input from operations based on their needs.

Complete qualitative gap analysis against CSA Z767 standard using the self-assessment sheets.

Develop action plans and other tools and resources to address identified areas for improvement.

Create library of PSM policies and procedures for operations to refer to and adapt accordingly.

Develop PSM implementation, site-specific and industry benchmarking process safety KPIs to monitor and report out on progress.

Develop additional guidance and resources to support operations for determining the effectiveness of PSM element implementation, as part of the Plan-Do-Check-Act cycle.

WHAT PSM LOOKS LIKE FOR CANADA'S PELLET SECTOR & NEXT STEPS

Live polling and discussion

GETTING BUY-IN FROM ALL LEVELS

WOOD PELLET ASSOCIATION OF CANADA

Gordon Murray
WPAC

GETTING BUY-IN FROM ALL LEVELS

- Expected WorkSafeBC will continue to encourage process industries to implement PSM.
- We have a chance now to proactively roll-out PSM over an achievable time frame (5-7 years) on our own terms.
- Meeting on November 24 to seek member commitment.
- To succeed, we need:
  - Buy-in from all levels
  - Long-term commitment from all levels
  - Regulator buy-in

PSM IMPLEMENTATION STRATEGY

Communicate and evaluate research outcomes; provide recommendations and gain consensus from stakeholders on the next actions.

Establish PSM Steering Committee, who will provide input on workplans, timelines and material and process development.

Develop process to provide ongoing support across the industry.

Develop implementation guide, workplan and milestones.

Develop self-assessment worksheets for each of the PSM elements.

Develop additional resources with input from operations based on their needs.

Complete qualitative gap analysis against CSA Z767 standard using the self-assessment sheets.

Develop action plans and other tools and resources to address identified areas for improvement.

Create library of PSM policies and procedures for operations to refer to and adapt accordingly.

Develop PSM implementation, site-specific and industry benchmarking process safety KPIs to monitor and report out on progress.

Develop additional guidance and resources to support operations for determining the effectiveness of PSM element implementation, as part of the Plan-Do-Check-Act cycle.

THREE PHASE PROCESS

The implementation of the PSM elements has been broken down into three phases so it is achievable for smaller organizations.

PHASE 1

- Accountability
- Process safety culture
- Process risk assessment and risk reduction
- Management of change (MOC)
- Investigation
- Key performance indicators (KPIs)

PHASE 2

- Conduct of operations — senior management responsibility
- Process knowledge and documentation
- Human factors
- Training and competency
- Process and equipment integrity

PHASE 3

- Emergency management planning
- Project review and design procedures
- Audit process
- Regulations
- Standards and codes
- Enhancement of process safety knowledge

CLOSING REMARKS

Gordon Murray (WPAC)
Julie Griffiths (Shaw Renewables)
Mike Tasker (WorkSafeBC)

WOOD PELLET
ASSOCIATION OF CANADA

REFERENCES

- Canadian Standards Association (CSA). (2017). Process safety management. CSA-Z767-17, National Standard of Canada. Toronto, ON: CSA Group.
- Chemical & Engineering News. *Tesoro Hit in CSB Report*. Last accessed Nov. 3, 2023 from https://cen.acs.org/articles/92/i5/Tesoro-Hit-Accident-Report.html
- Hopkins, A. (2005). Safety, Culture and Risk. Sydney, Australia: CCH Australia Limited.
- Forbes (2019). *Have We Learned The Alcoa 'Keystone Habit' Lesson?* Last accessed Nov. 3, 2023 from *https://www.forbes.com/sites/roddwagner/2019/01/22/have-we-learned-the-alcoa-keystone-habit-lesson/*
- International Atomic Energy Agency (IAEA) (2023). "Radiation Safety Culture Trait Talks" Last accessed October 31, 2023 from https://www.iaea.org/sites/default/files/21/01/radiation-safety-culture-trait-talks.pdf
- Uno, K. Analysis of Safety Culture Weaknesses in Chemical Safety Board Investigation Reports. *From Proceedings of 18th Asian Pacific Confederation of Chemical Engineering Congress (APCChE 2019).* Last accessed Nov. 3, 2023 from https://www.matec-conferences.org/articles/matecconf/pdf/2021/02/matecconf_apcche21_10001.pdf
- US Chemical Safety Board (US CSB). *Tesoro Anacortes Refinery Fatal Explosion and Fire*. Last accessed Nov. 3, 2023 from https://www.csb.gov/tesoro-anacortes-refinery-fatal-explosion-and-fire-/
- US Chemical Safety Board (US CSB). *Williams Giesmar Explosion and Fire*. Last accessed Nov. 3, 2023 from https://www.youtube.com/watch?v=Z1KaykPaF8M


WOOD PELLET
ASSOCIATION OF CANADA