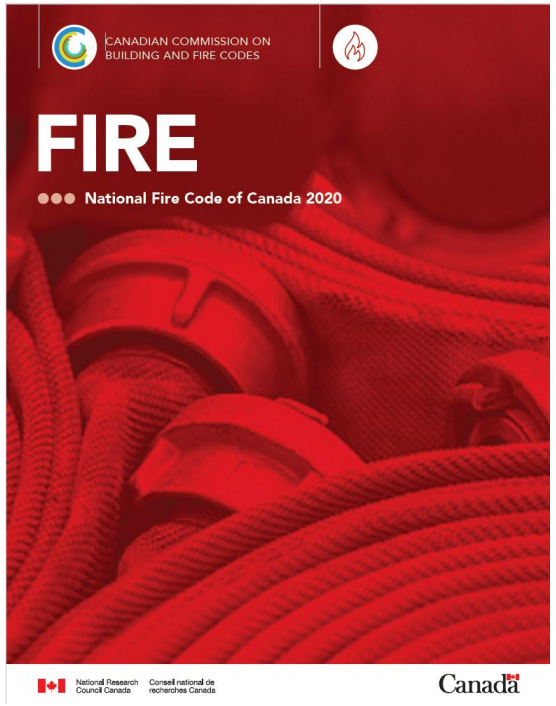
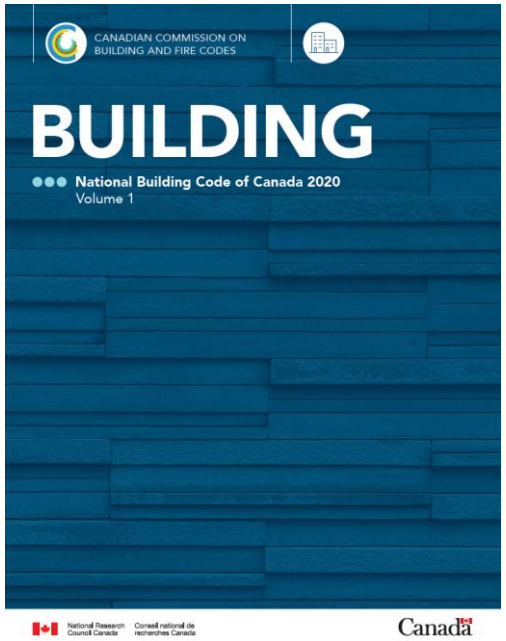
Improving process safety through code compliance : Gaps in fire and building codes of Canada





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About Speakers

Tyler Olinek, P.Eng. (Alberta)

- Lead Engineer, Process Engineering and Process Safety for ATCO EnPower
- 5+ years of experience working for ATCO and 8 years for CNRL.
- Projects: quantification of failure mechanisms to improve facility availability, wireline, conventional oil and gas, refinery operations and technical safety, gas processing, and energy transition initiatives.
- Certified in Functional Safety from TUV Rheinland, BSc Chemical Engineering - University of Alberta

Modusser Tufail (Mod), P.Eng.

- Fire Protection Engineer at Strathcona County Emergency Services, AB
- Certified Fire Protection Specialist from NFPA and Certified Process Safety Professional from AIChE-CCPS.
- Contributes in National Model Codes Committee of Codes Canada for development of Fire and Building Codes
- Executive Member of PSMD Division of CSChE

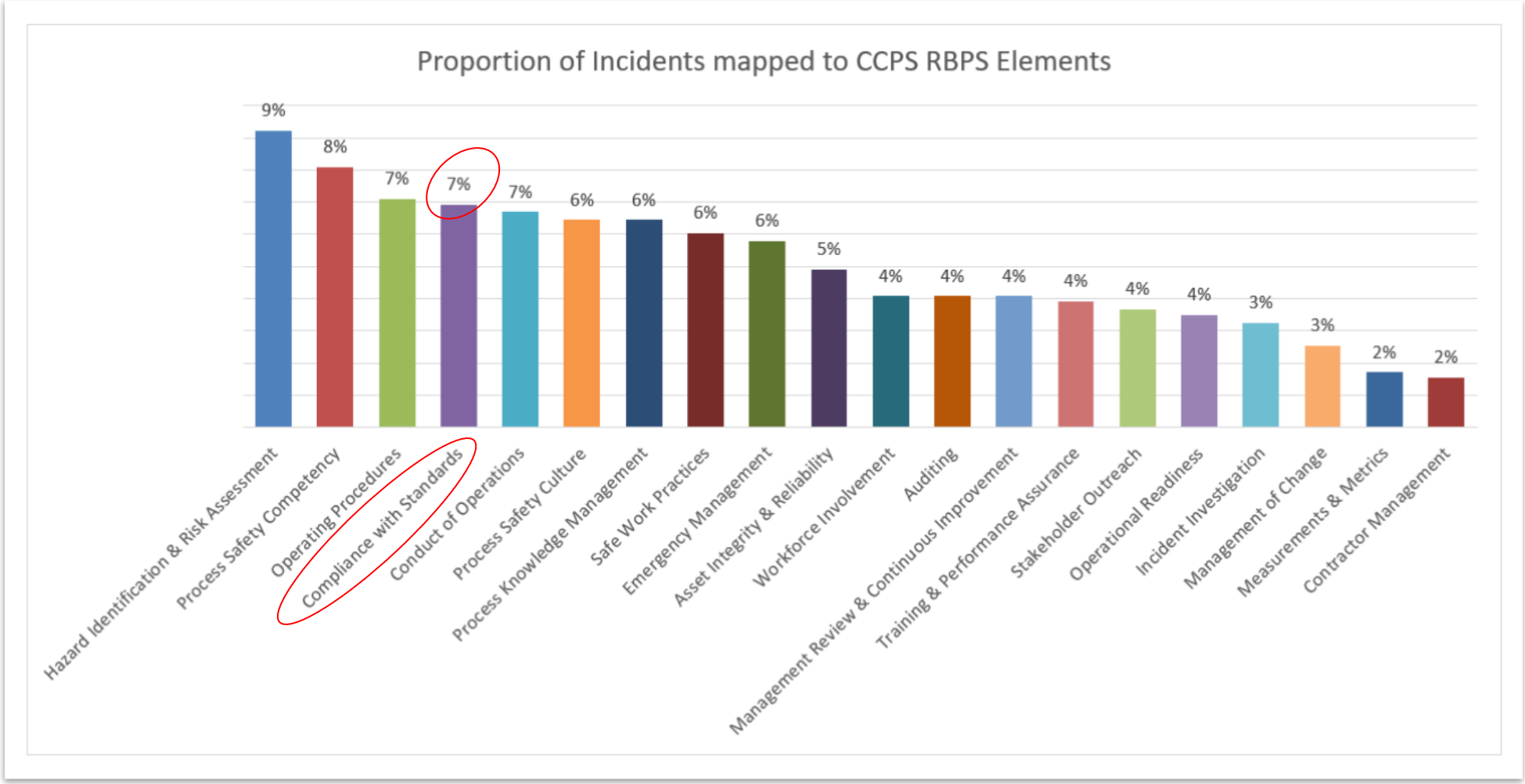
Agenda

- Causes of PSM Incidents
- Process Safety elements in fire and building codes of Canada
- Industrial Facilities
  - Bulk Plants
  - Process Plants
  - Industrial Buildings
- Example Situations
- Observations and Recommendations

Hazardous Materials

- List of 249 Hazardous Materials in Environmental Emergency Regulations SOR/2019-51
- Exceeding thresholds = offsite impact = higher risk
- Helps in hazard identification of industrial risk management
- Relevant to process plants, bulk plants, industrial buildings and storage facilities like tank farms, warehouses, including railyards storing hazardous materials on tank cars

Causes of PSM Incidents



Source: Process Safety Integrity (Data from MKOPSC)

NFC and NBC in Industry Standards

- PSM Element : Code Compliance
- Canadian Industry standards refer to National Fire Code of Canada
- CSA Z662:23 : e.g. Pipelines and Tank Farms
  - Design and construction of all aboveground tanks - 4.15.1.1 and 4.15.2
  - Design and construction of underground storage tanks – 4.15.3,
  - Corrosion of underground tanks – 9.1.2
  - Storage of fuels and lubricants (suitable distance from compressor and pump building, protection of aboveground storage tanks) – 10.9.1.5
- CSA Z767:24 : e.g. Process Plants
  - Regulations, codes and standards 5.2.1, 5.2.2, 5.2.3

Process Plants

Process plant means an *industrial occupancy* where materials, including *flammable liquids*, *combustible liquids* or gases, are produced or used in a process.

4.9.4.3 - Fire Protection 1) The risks of fire and explosion at process plants shall be evaluated based on a) material properties, b)material quantities, c)operating conditions, d)arrangement of stored materials, e)transportation of materials, f)process design, and g) operating and maintenance procedures.	2) Based on the evaluation required in Sentence (1), measures to minimize the occurrence of fires and explosions and to mitigate their effects shall be identified. 3)* Where the process warrants protection, process plants shall be supplied with a)water supplies of adequate pressure and quantity to meet the probable fire demands, b) hydrants, c) hoses connected to a permanent water supply and located so that all equipment containing flammable liquids or combustible liquids, including pumps, can be reached with at least one hose stream, and d) fire protection systems conforming to Part 2.

*Statements of 4.9.4.3 (3)
F03 To retard the effects of fire on areas beyond its point of origin.
F12 To facilitate emergency response.

Fire and Building Codes of Canada

- Objective Statements
  - Fire Safety
  - Fire Protection of Buildings and Facilities
  - Protection of Adjacent Building or Facilities from Fire
  - Theme: To limit the probability that entities will be exposed to an unacceptable risk

- Functional/Prescriptive Statements
  - Conditions/Requirements that satisfy the objectives
- Acceptable risk = risk remaining after compliance

Code Compliance

- Done through permit system and inspections of municipalities/regulators
- Permits
  - Development Permit
    - land use bylaws,
    - triggers of federal, provincial and local municipal regulations
  - Building Permit (Building Code)
  - Occupancy Permit (Building Code)
- Inspections
  - Bylaw Inspections
  - Fire Inspections – construction stage (Fire Code)
  - Fire Inspections – occupancy stage (Fire Code)

Gaps: Examples

- An existing factory processing hazardous materials has decided to decrease the number of private hydrants on site
- A bulk plant is increasing outside storage of flammable and combustible liquids on site that exceeds thresholds of Environment Canada (ECCC)
- A facility decides to remove special hazard fire protection system of control room building to decrease maintenance cost

Examples - 2

- A tank farm storing crude oil decides to store gasoline in the same tanks
- The main fire pump of the facility is no longer required due to availability of a municipal water supply
- Remark: There is no article that helps management of change related to site operations and adequacy of protection

Examples - 3

- Applying Occupancy Classification on Industrial building
  - F1 – High Hazard
  - F2 – Medium Hazard
  - F3 – Low Hazard

Remark: Prescriptive code hinders in protection of diverse industrial processes requiring unnecessary protections just to meet the code. e.g. tall industrial buildings with elevators, protections of low hazard processes in buildings classified as F1

Gaps: Bulk Plants

Section 4.7 Bulk Plant:

- *“portion of property where flammable liquids or combustible liquids are received in bulk quantities and are stored or handled for the purpose of being distributed” – 4.7.1.1*
- Need:
  - Objectives: achieve fire safety and fire protection of the building from fire or explosion impacting areas beyond its point of origin
  - F02 - To limit the severity and effects of fire or explosion
  - F12 - To facilitate emergency response
- Fire Protection – portable fire extinguishers 4.7.5.1
- Gap :
  - objectives not achieved with just fire extinguishers
  - risks are not managed when material quantities exceed E2 thresholds

Gaps: Process Plants

Process plant means an *industrial occupancy* where materials, including *flammable liquids*, *combustible liquids* or gases, are produced or used in a process.

What qualifies as a process plant?

- Combustible dust producing processes?
- Hydrogen refueling station?
- Cannabis extraction unit?
- Ammonia Plants of Ice rinks?
- Battery Energy Storage System?
- Manufacturing plant? Factories? Bulk Plants?

Identified Gaps

- No design document is retained asHazard Identification or a commitment of protection or safeguard for life of facility or occupancy
- No management of change to cater material or volume fluctuations, introduction of new materials, or change of industrial processes
- No consideration to sites exceeding E2 thresholds e.g. bulk plants.
- Inconsistent definitions of some terms e.g. process plant, bulk plants, F1/F2 classification of buildings

Recommendation 1

- Just like building code requirements of Schedules, there must be a schedule for professional involvement of Process Safety/Fire Protection Engineers where hazardous materials are involved e.g.
  - Fire Protection Design Basis
  - Engineering Assessment/Evaluation on adequacy of protection or safeguards

- Currently these are required from Civil Engineers for Structural Design, Electrical Engineer for Power and Fire Alarms, Mechanical Engineers for Sprinklers and HVAC Systems for most of the building permits.

Recommendation – 2: code change

- For Process Plant 4.9.4.3 Fire Protection
- *2) Based on the evaluation required in sentence 1, measures to minimize the occurrence or fires and explosions and to mitigate their effects shall be identified in a fire protection design basis.*
- *a) FPDB will be maintained and updated throughout the life of facility capturing site changes.*
- *b)This document will be available at site for code enforcement officer for a review.*
- Appendix to this article should provide guidance and refer to Canadian documents for industrial risk management including
  - CSA Z767 Process Safety Management Standard
  - Risk Management – Risk Assessment for Industry and Municipalities – CSCHE Publication,(MIACC Guidelines)

Recommendation 3

- Bulk Plant to replicate 4.9.4.3 to the script of 4.7.5.1

Conclusion

1. With existing codes, building permits are ineffective to keep up with site changes. Three recommendations provided for code change.
2. Engineering assessments of Process Safety Engineers/Fire Protection Engineers must be triggered for higher risk occupancies. Life cycle approach in code compliance of process plants is needed.
3. Consistency in inspections without design basis document is difficult. These records need to be maintained for the life of the facility.

    E.g. risk assessment, fire protection design basis, drawings/plans

Thanks

Questions?