Process Safety Implementation in a Greenfield Refinery Project in Alberta

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North West Redwater Partnership (NWR) project is building Alberta’s newest stand-alone refinery (first in 30 years) with a processing capacity of over 78,000 bpd of dil. bitumen.
OUR MISSION
To build, operate and grow a safe, profitable and environmentally responsible bitumen refinery creating high value products for Alberta and the world.

OUR VALUES
Integrity. Respect. Trust. Results.

NWR’s Mission Statement
Demonstrating visible and consistent commitment to personal and process safety.
Refineries process hydrocarbons at high temperature and high pressure

A leak of high-pressure gaseous hydrocarbon can, if it ignites immediately, produce a jet fire which may impinge on other process plant and then escalate to become a large conflagration.

An un-ignited leak of high-pressure gaseous hydrocarbon can quickly generate a large, inflammable cloud which may drift until it finds an ignition source, and it can then yield a vapor cloud explosion.

A spill of liquid hydrocarbon may catch fire and yield a pool fire.

How does Process Safety matter?

Property Damage values of 100 largest losses by sector

Property Damage values of 100 largest losses by event type
What is Goal Zero?
How will NWR operations work?

The “Gear Model” depicts the **independence & interdependence** of Process Safety with other NWR organizational functions, and the common purpose of supporting Operations.
The NWR PSM program was developed in 2011 and has 18 elements based on OSHA and other programs.

NWR is evaluating CSA-Z772 impacts on their program.

The NWR PSM philosophy is to adopt the program elements that are most relevant to the following:
- Regulatory requirements in Alberta
- Best practices & RAGAGEP in the global refining industry
- Elements that support building a strong culture of leadership & employee accountability, & Operational Discipline

14 NWR PSM elements are based on OSHA which is often seen as best practice in countries with no PSM legislation.
## 18 Element NWR PSM program

### Elements by Owner

<table>
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<tr>
<th>Process Safety</th>
<th>Maintenance &amp; Reliability</th>
<th>Operations</th>
<th>Management/Leadership</th>
<th>HSE</th>
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PSM is a **stay-in-business strategy** and will be an integral part of Goal Zero.

PSM will only succeed by establishing a **strong and consistent culture** and will **drive rigor and discipline** into a new start-up organization.

PSM will be a leader in fostering a **Risk-Based Decision Making mindset** matching the level of controls and resources to the risk.

Accountability is distributed across the operating organization, and best led by Operations and Maintenance.

Process safety management is **an activity distinct** from occupational safety.

Maintain a **healthy sense of vulnerability** regarding process safety risks.

**Continuously learn** from past incidents.
Risk Management is the systematic application of management policies, procedures and practices to the tasks of analyzing, assessing and controlling risk in order to protect stakeholders, company assets and the environment.
There are 2 risk matrices in NWR

- **PSM Risk Matrix**
- **Sustained Operations Risk Matrix**

PSM matrix is intended for use in PHA’s that consider industry-wide potential events on a longer time horizon (1,000 years or more).

*This Risk Matrix was used in HAZOPs, PHA etc.*

Sustained Operations matrix is designed to estimate likelihood of events in the time horizon of the Sturgeon Refinery asset life.

*This Risk Matrix will be used in the Run and Maintain Organization.*
Management of change (MOC) is a process safety management (PSM) best practice implemented to ensure that health, safety and environmental risks are controlled and managed, when a company makes changes to the facility (assets), documentation, personnel, or operations.

The main driver of MOC is avoiding the consequences of unforeseen safety and health hazards through planning and coordination of the implementation of change.

In NWR:

- **Facility Management of Change (FMOC)**
- **Facility Impairments**
- **Procedure Management of Change**
- **Organizational Management of Change**
- **Business Process Management of Change**
- **Information Systems Management of Change (ISMOC)**
- **Management of Information Change (MOIC)**
“Situational” refers to the focus on **one specific issue or potential hazard**, rather than a broad survey such as in a PHA (guideword HAZOP)

Situational Risk Assessments (SRA) fit the need for an **efficient, straightforward, team-based tool** for supporting:

- Day-to-day risk-based decision making,
- Operations Management of change (e.g., FMOC, Impairments)
Understanding risk begins with accurate process knowledge.

Substandard PSI has been identified as a contributing or root cause of approximately 20% of process safety incidents.

The primary objective of the PSI element is to gather and maintain accurate, complete, and understandable information that can be accessed on demand.

Process Safety Information

- Process Safety Management Manuals
- Process Overview Manuals
- Chemical Incompatibility Matrices
- Operating Modes
- Fire protection Manual
- Siting Manual
- Pressure Equipment Integrity Manual
- Corrosion Manuals
- Asset Care Plans
- Emergency Shutdown Procedures
- MSDS Manuals
- Other primary engineering design documents
What are Process Safety Management Manuals?

- Understand the ‘Why’ of safeguards
- Understand the various lines of defence against loss of containment
- Understand safeguards from HAZOPs, LOPA and other interconnected units

Diagram:
- Safe operating limits
- Over pressure protection
- Over temperature protection
- Instrumented protection against LOCE
- Low Temperature protection
- Other Safeguards
- Unit specific utility failure contingencies
A Pre Start-up Safety Review is a rigorous review process for identifying, understanding and prioritizing risks at start-up.

It is intended to be a validation or verification of readiness; a series of checks and balances that culminate in the final energization authorization prior to facility, unit or sub unit start-up.

Everyone at NWR has responsibilities in some aspect of their role to ensure readiness for start-up.

PSSRs are widely used in the industry and in some places legally required.
To facilitate effective PSSR execution we have:
- Defined smaller manageable systems.
- 83 PSSRs have been identified to be completed.

To facilitate effective Reviews we have:
- Segmented each PSSR over 3 distinct phases.
Culture does not exist apart from the company itself, no company has a culture; every company is a culture.

~ Peter Thiel, Zero to One, Notes on Start ups, 2014
Operational Discipline

1. Do the right thing
2. the right way
3. every time

Risk = (Severity x Consequence)/(Op. Discipline)^n, n>1 for better OD
Operations supports PSM through the implementation of **Operations Discipline Standards** to ensure that operations tasks are executed in a deliberate, controlled and structured manner.

- Setting standards of conduct eliminates an atmosphere of “casual compliance” and prevents normalization of deviance.

- There are six elements:
  - **Abnormal Operations**-(i.e. Operating modes, Emergency Response plans)
  - **Operations Etiquette**-(i.e. Control Room Etiquette, Radio Etiquette)
  - **Operations Monitoring**-(Unit surveillance)
  - **Operations Start of Shift**-(i.e. Daily Orders, Operator Logs)
  - **Shift Team Meeting**
  - **Shift Turnover**-(Blues to Blues, Quality Handovers)
Top 6 traits of a strong Process Safety Culture

1. Leadership
2. Operational Discipline
3. Empowered Employees
4. Systems and processes
5. Open communication & trust
6. Learning culture, training

Process Safety Culture in NWR
Process Operator Training Pathway

1) New Hire Orientation
2) Refinery Overview
3) Core Competency Training (L1)
4) Process/Equipment Fundamentals
5) HSE/ER Training
6) Standards, Business Processes and e-Tools Training
7) Unit Overview Training (UOT)
8) Process System Training (PST) 1, 2, 3 ....
9) PSM Manual Training (PSMT)
10) Process Control Training (PCT)
11) Job Specific Training (JST)

Competent Operator proceeds to next post qualification

Seasoning Time

New Hire

Core Training

Post Specific Training

Training Delivery Method
- Online / Computer Based Training
- Instructor/Mentor Led Training
- OTS / OJT
- Blended Learning

Competency Validation Method
- Pre-training Knowledge Test
- Post-training Knowledge Test
- Post-training Skill Test

Applies to Control Room Operator only
Asset Integrity and Reliability

92.6% Sustainable Pacesetting Performance in Maintenance & Reliability at Optimum Cost

Management Systems
Materials & SCM Management
Turnaround Management
Site Infrastructure
M&R Readiness (RCM, RBI, IOW)
Asset Hierarchy

Asset Information Management (Master Data)
MRM Strategies, Plans & Processes
The Team & Organizational Readiness
MRM Vision, Mission, Values (CULTURE)
Ultimate aim of PSM implementation in NWR is to ensure that with a strong process safety culture, the future operational organization is able to operate the facility in a safe, profitable and environmentally responsible manner to create high value-added products for Alberta and the world.