



Process Safety Implementation in a Greenfield Refinery Project in Alberta

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About the Project



North West Redwater Partnership (NWR) project is building **Alberta's newest stand-alone refinery (first in 30 years)** with a processing capacity of over 78000 bpd of dil. bitumen

NWR's Mission Statement

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.



Our success depends on being highly motivated, being in NWR, understanding our individual roles and contributing by:

Demonstrating visible and consistent commitment to personal and process safety;

- Performing at the best every day on every task;
- Honouring our commitments;
- Encouraging and practicing open, honest and regular communication;
- Taking calculated risks while using sound business judgment;
- Allowing those that are impacted by the outcome to make knowledgeable decisions;
- Working at the right level of detail, without duplication or omissions;
- Aligning toward common rather than conflicting goals;
- Managing setbacks within a culture of learning, while promoting continuous learning & development;
- Supporting a work environment where people feel valued and are able to make a difference;
- Celebrating successes and having fun at work;
- Making NWR a place where we are all proud to work.



Demonstrating visible and consistent commitment to personal and process safety

How does Process Safety matter?

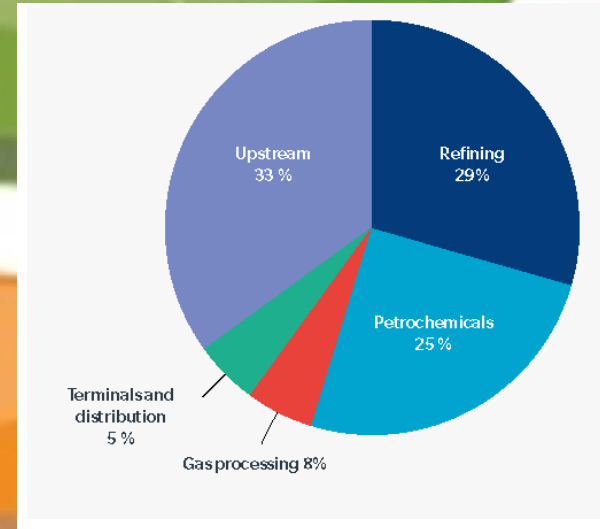
Refineries process hydrocarbons at high temperature and high pressure

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

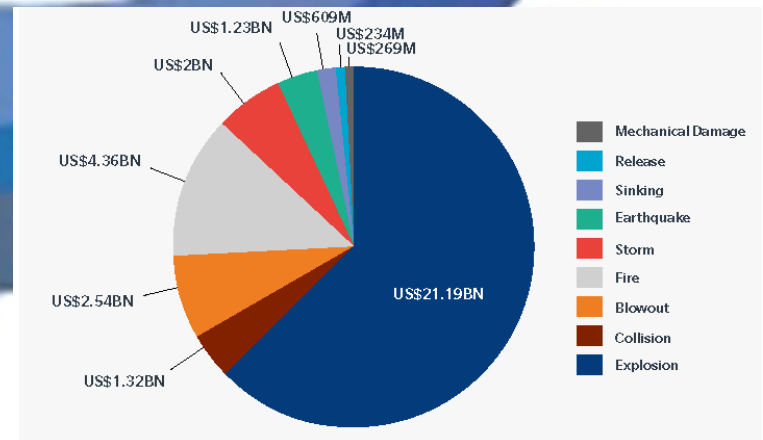
An un-ignited leak of high-pressure gaseous hydrocarbon can quickly generate a large, inflammable cloud which may drift until it finds an ignition source, and it can then yield a **vapor cloud explosion**

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

Property Damage values of 100 largest losses by sector



Property Damage values of 100 largest losses by event type



What is Goal Zero?



Goal Zero

Emergency Response

Environment

Industrial Hygiene

Occupational Health

Occupational Safety

Security

Process Safety

Process Safety Information
PHA
Operations Procedures
MOC
Asset Integrity (LOCE)
PSSR
Operations Discipline

HSE Manual (Common Elements)

PSM Implementation Plan

Safety Culture

Safety Commitment

Communication

Leadership

Initiative

Adapatability

Collaboration

Integrity

Respect

Trust

Results

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



NWR's PSM program

- ❑ 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

Process Safety	Maintenance & Reliability	Operations	Management/ Leadership	HSE
8. Process Safety Information	12. Asset Integrity	4. Competency Assurance	1. Employee Involvement	3. Contractor Safety
9. Process Hazard Analysis		10. Operating Procedures	7. Auditing	5. Incident Management
11. Management of Change	Engineering	13. Pre-Start up Safety Review	Process Engineering	6. Emergency Response Planning
17. Process Safety Culture	18. Compliance to Codes & Standards		15. Operational Discipline	2. Trade Secrets/ Business Integrity

NWR PSM Implementation Guiding Principles

- ❑ 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 in NWR

Business Planning and Strategy

Operations Risk & Loss Management

Risk Identification

Risk Assessment

Risk Mitigation Planning

Action and Follow-up

□ 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

Risk Matrices in NWR

- ❑ 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).

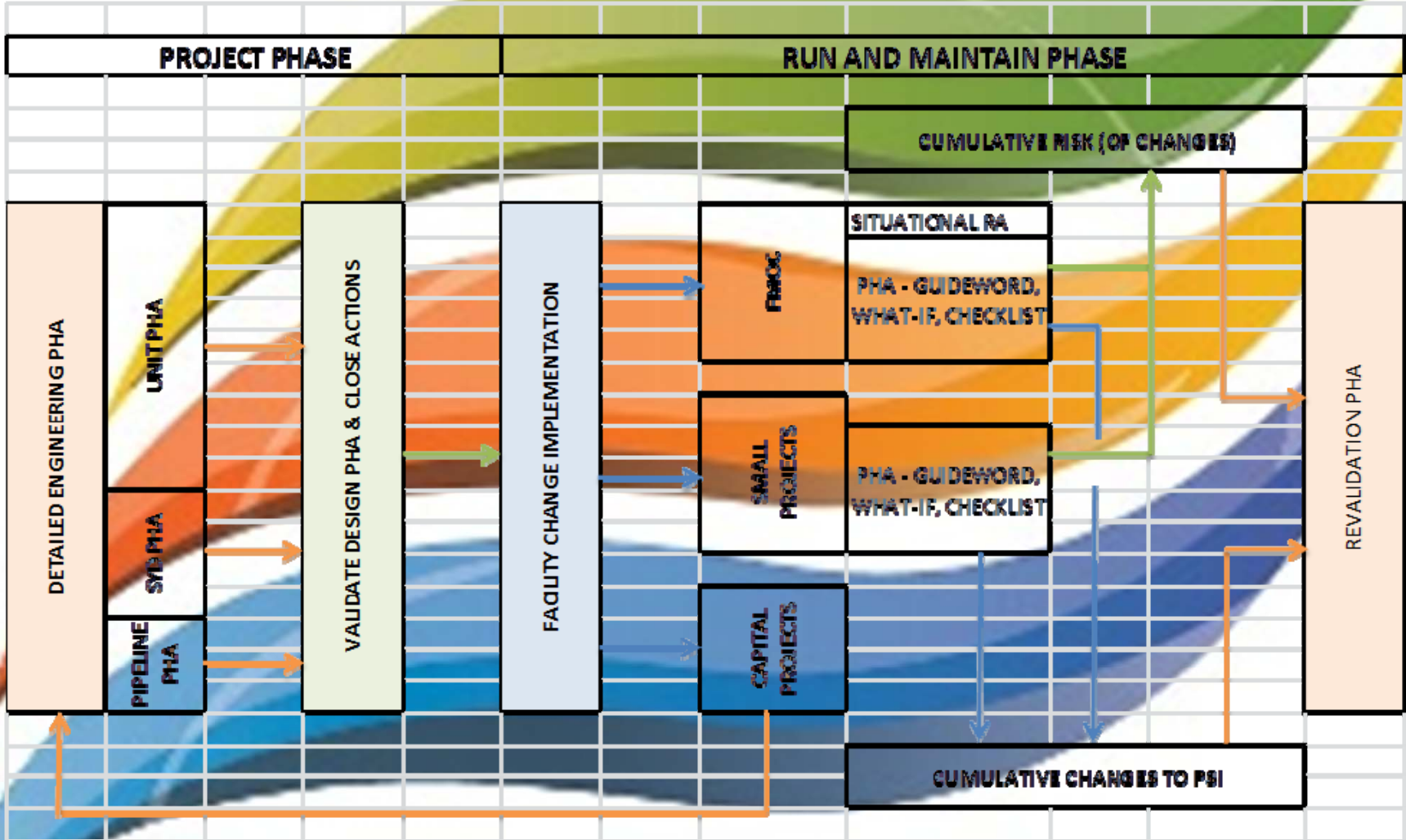
This Risk Matrix was used in HAZOPs, PHA etc.



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.

NWR PHA Lifecycle Block Flow Diagram



MOC in NWR: The What & Why?

- ❑ 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 Risk Assessments

- ❑ “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)**



Process Safety Information

- ❑ 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 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

Safe operating limits

Over pressure protection

Over temperature protection

Instrumented protection against LOCE

Low Temperature protection

Other Safeguards

Unit specific utility failure contingencies

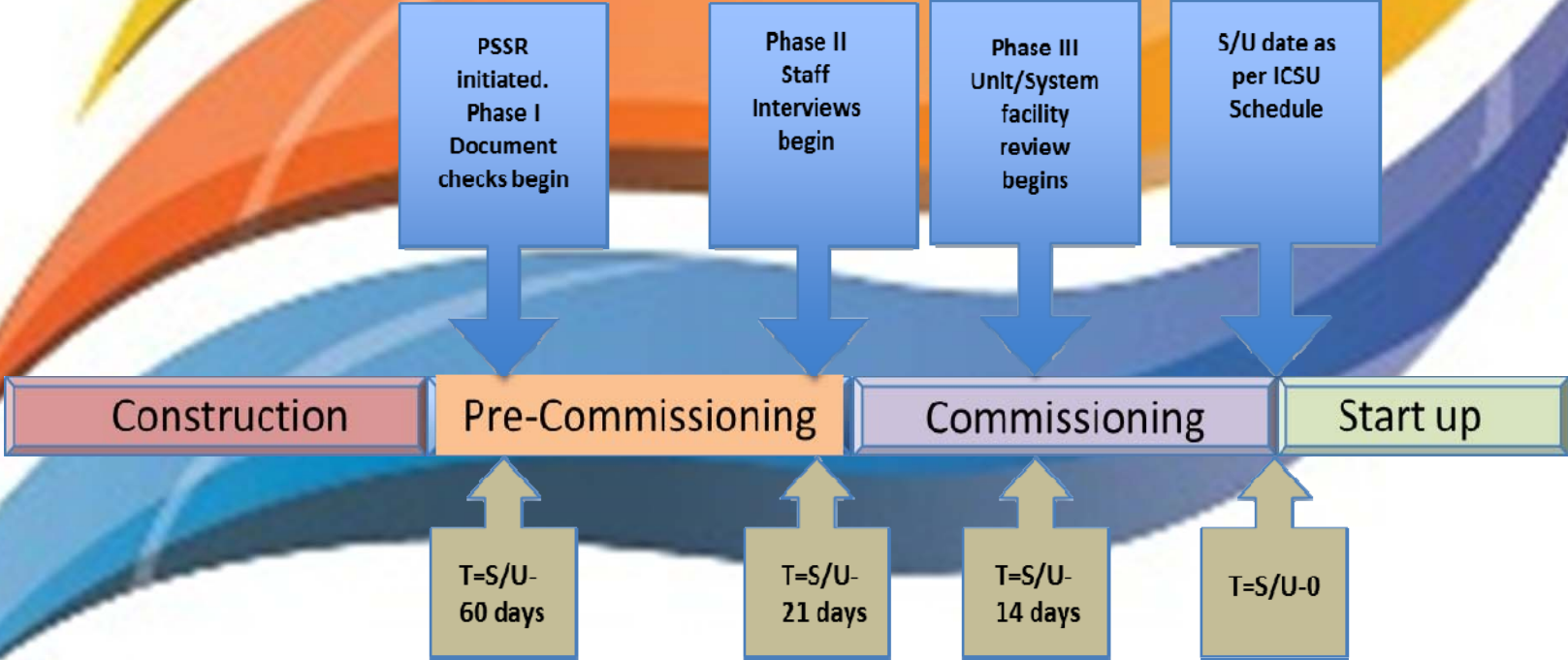


Pre Startup Safety Reviews in NWR

- 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

PSSR: General plan overview

- ❑ 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

Shift Operational Discipline

Operational Discipline

1 Do the right thing

2 the right way

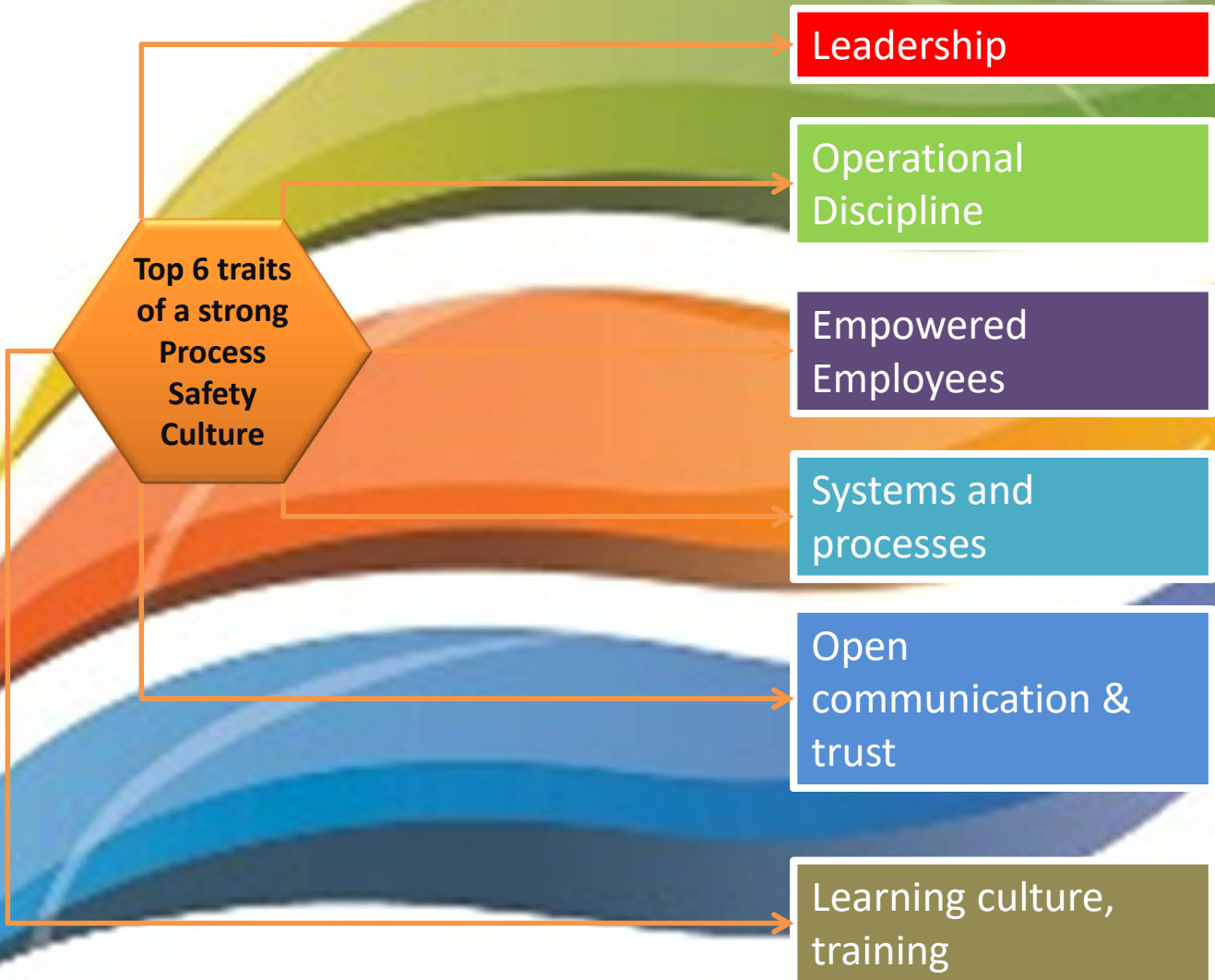
3 every time

Risk = (Severity x Consequence)/(Op. Discipline)ⁿ, n>1 for better OD

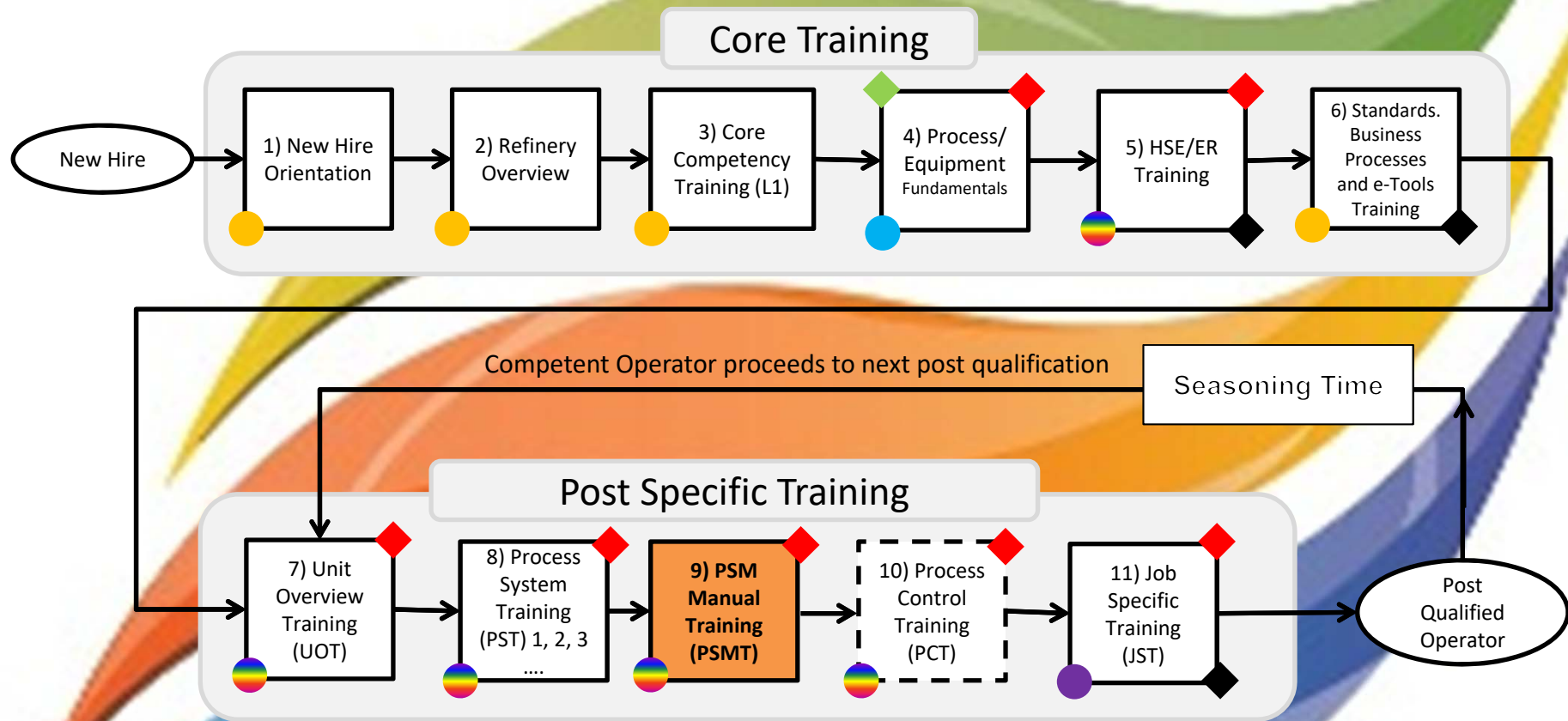
Shift Operations Discipline

- ❑ 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 pre-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)

Process Safety Culture in NWR



Process Operator Training Pathway



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)

Concluding



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.