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1.0 Purpose

The purpose of the Fire and Explosion Hazard Management Practice is to understand and control the hazards and manage risk associated with fire and Explosion potential in wells and associated surface equipment.

2.0 Scope/Application

This Fire and Explosion Hazard Management (FEHM) Practice applies across the Canadian Region to any situation where air and fuel may combine in a wellbore or associated surface equipment. Business functions where these situations may occur are Drilling, Completions and Well Servicing Operations. Some wellbore activities may be directed by Production Operations.

The Alberta and Saskatchewan regulatory requirements are found in Appendix A.

3.0 Fire and Explosion Hazard Management Requirements

During wellbore activities if there is a potential for the fire triangle to be complete, there must be a documented FEHM Plan in place. A form intended for use at the worksite has been designed to meet the requirements of an FEHM Plan, see Appendix C.

3.1 General Fire and Explosion Considerations

a) Explosions still occur because people believe that ignition is impossible. The elimination of ignition sources should not be accepted as the sole basis of control. It is recognized that it is difficult to control ignition sources in the wellbore. When fuel and air can combine in the wellbore, it must be assumed that there may be a source of ignition and that the fire triangle (see Appendix B) can be completed.

b) Efficient execution of wellbore activities relies on effective communication. Communication needs to be two way, appropriately documented, and includes factual information about the planned activities, the hazards, and the steps in eliminating or reducing the hazards.

c) Consideration must be given for hand-offs between supervisors and crews, concurrent operations, and the level of supervision of the contractor(s).

3.2 ERCB Directive 033 and Enform IRP Volume #18

In response to ERCB Directive 033, the Drilling and Completions Committee of Enform (in consultation with the University of Calgary) has prepared IRP #18 to address fire and Explosion hazard management.

Additionally, the IRP 18 Committee has a website at www.firesandexplosions.ca to provide information and management strategies regarding fire and Explosion hazards in the oil and gas industry.

**ERCB Directive 033: Well Servicing and Completions Operations - Interim Requirement Regarding the Potential for Explosive Mixtures and Ignition in Wells** which states that a licensee must:

- Have documented practices available at the well site for the safe management of the potential for explosive mixtures and ignition in wells and associated surface equipment, and

- Ensure that all well site staff responsible for well control and blowout prevention understand these practices and know how to apply them.
This interim requirement expands upon existing ERCB requirements for well control, blowout prevention, and crew training procedures to include an additional new requirement for addressing the potential for explosive mixtures and ignition in wells.

**IRP Volume #18, Fire and Explosion Hazard Management (2007)** - The purpose of IRP #18 is to improve worker safety by providing industry with:

a) A more thorough understanding of fire and Explosion hazards,

b) A process for identifying such hazards, and

c) Effective methods for managing these hazards.

**Note:** A Cenovus Guidance Document for ERCB Directive 033 and Enform IRP Volume #18 is found in Appendix D.

### 3.3 Pre-Job Hazard Assessment, Safety Meeting and Safe Work Permit

The Safe Work Permit (SWP) Issuer is responsible for:

a) **Deciding** if a written Fire & Explosion Prevention Plan is necessary based on the:

1) SWP System, or

2) Classified hazardous locations as per the “Code for Electrical Installations at Oil and Gas Facilities” that are less than 25 metres from the work area, or

3) Risk Assessment or Management of Change (MOC) process, or

4) Type of planned task, operation, or process. See work requiring a written plan. A planning flow chart is found in Appendix E.

**Note:** For most work, the pre-job hazard assessment, safety meeting, and the SWP process for the primary task by itself will be sufficient, but the SWP Issuer is responsible for deciding if the level of risk associated with the fire and Explosion hazards requires a written Fire & Explosion Prevention Plan which must be attached to the Safe Work Permit, see Appendix B.

b) Conducting a hazard assessment and ensuring all fuel, oxygen, and ignition sources are identified at or adjacent to the proposed work.

**Important Note:** All affected workers (i.e., the work crew) must be included in the pre-job hazard assessment and in the control or elimination of those identified hazards. Further, all other workers at the worksite or at other worksites affected by the work or hazards identified in the hazard assessment and SWP must be informed of the hazards and of the methods used to control or eliminate the hazards.

c) Ensuring all fire and Explosion hazard controls are:

1) Compatible with the practices or procedures being used to complete the primary task.

2) In compliance with government regulations and the equipment manufacturer’s instructions/specifications.

3) Holding a safety meeting where all aspects of the job, the Fire & Explosion Prevention Plan, and SWP are discussed.
4.0 Work Requiring a Fire & Explosion Prevention Plan

Cenovus requires a Fire & Explosion Prevention Plan for all:

a) Drilling, completions, well servicing and testing, or
b) Other work identified by the business unit (BU).

Depending on the risk for fire and Explosion, the following jobs may require a Fire
& Explosion Prevention Plan:

a) Non-routine, high-risk work where there is a risk for fire or Explosion
(i.e., hot work, purging, hot oiling),
b) Electrical work as identified by Cenovus’s Electrical Department,
c) New facility construction or process equipment installation,
d) New or modified production processes (i.e., Management of Change process),
e) Work requiring bypassing safety shutdown devices,

Note: Some complex systems may require a technical review by a specialist
before approval is granted to bypass the safety shutdown system.

f) As required by Cenovus’s SWP System.

g) Cenovus’s Worksite Supervisor or Safe Work Permit Issuer may require new or
transferred employees and contractors to complete a fire and Explosion hazard
assessment as part of the evaluation, inspection, and/or audit process.

4.1 Examples of Work Requiring a Plan

Examples when a site-specific Fire & Explosion Prevention Plan may be required include:

1. Well Site Operations
a) Where oxygen-air or oxidizing chemicals are purposely used or inadvertently
introduced into well drilling and servicing operations.
b) All snubbing applications.
c) All well workover applications using hydrocarbon-based fluids.
d) Wire line work using a lubricator.

2. Production Operations
a) Planning and execution of a facility turnaround.
b) Start-up of new equipment.
c) Well in-line testing.
d) Preparation and/or cleaning of tanks and vessels (i.e., confined space entry).
e) Fluid level shots using cartridge-style system.

3. Repair and Maintenance Activities
a) Modification of vessels, equipment, piping, pipelines that have contained
hydrocarbons (i.e., hot work).
b) All operations involving the use of propane torches to heat or thaw systems containing hydrocarbons.

4. Trucking Operations
   a) All tank truck repairs and maintenance.
   b) All vacuum truck operations involving the removal of hydrocarbon fluids.

5.0 Training
   a) Well-informed and experienced well site supervision is a key to successful management of wellbore activities. Cenovus requires that personnel involved in wellbore activities are suitably trained. Local EH&S Coordinators are available to set up training in a format appropriate to meet the BU needs.
   b) Establishing and tracking competency can be done using the Cenovus Learning Management System (LMS) or other equivalent tracking methods.
   c) The required training for Cenovus staff is:
      - Cenovus CEN_EHS019, Hazard Assessment and Control Practice
      - Cenovus CEN_EHS039, Fire and Explosion Hazard Management Practice
      - Cenovus PowerPoint Presentation (by Aaron Smith, Sam Tschetter, and Jeff Mazurak) Fire and Explosion Hazard Management
   d) Contractors shall provide equivalent levels of hazard assessment training that include fire and Explosion management, specifically the fire triangle and critical risk factors.

6.0 Roles and Responsibilities
   Roles and responsibilities for safety documents are described in the link below:
   Roles and Responsibilities Standard
   Roles and responsibilities specific to this practice are described below:
   Wellbore fire and Explosion safety must be the joint responsibility of management, field, and contract personnel. This includes those that plan, implement, and execute wellbore activities with fire and Explosion hazards.

6.1 Well Program Planner
   Well Program Planners are responsible for:
   a) Ensuring that the potential for completion of the fire triangle and expected critical risk factors are identified in the work plan or program.
   b) Identifying the necessary controls which are to be put into place during wellbore activities. It is required that engineering controls be considered prior to, and in addition to, the use of administrative or personal protective equipment (PPE) controls. The controls must reduce the risk of fire and Explosion to a point where the activities can proceed safely with confidence.

6.2 Well Site Supervisor
   The Well Site Supervisor is responsible for:
   a) Having the training to recognize the need for and complete an FEHM Plan if required.
b) Assessing the conditions for the presence of the fire triangle and/or critical risk factors during operations.

c) Ensuring that appropriate controls are in place such that they will reduce the initial risk to a point where the activities can proceed safely with confidence. It is required that engineering controls be considered prior to, and in addition to, the use of administrative or PPE controls.

d) Determining the level of risk associated with the operation based on the conditions observed in the field and controls put into place, and then complete the required procedures as outlined in the FEHM Plan.

e) Continually monitor for changes that could affect the conditions and/or controls in place.

f) Communicating the FEHM Plan to all workers at the worksite and all services that have been requested to provide equipment, services, or procedures for the planned operations.

6.3 **Contractors**

All contractors are responsible for:

a) Supplying/providing IRP #18/ERCB Directive 033 compliant equipment and services.

b) Ensuring their personnel are able to provide the company’s documentation, understand its content, and confirm that they have been trained.

7.0 **References**

7.1 **Internal References**

1. Cenovus EHS425 *Fire and Explosion Hazard Management Form*

7.2 **External References**


2. Enform IRP Volume #18, *Fire and Explosion Hazard Management (2007)*

8.0 **Change Management**

Proposed changes to this practice can be directed to EH&S Document Management

9.0 **Definitions and Acronyms**

Definitions and acronyms for safety documents are described in the link below:

Cenovus CEN-EHS243, Definitions and Acronyms

The following definitions and acronyms are specific to this practice.

**Critical Risk Factors** means that each of the following risk factors increase the fire and Explosion potential and must be considered in operational and control decisions. These factors include the presence of liquid hydrocarbons, H₂S, oil-based workover fluids, high pressure or temperature, rapid pressure or temperature changes, flow into closed system, pre-existing trapped air, and mixing of products or chemicals.
Fire and Explosion Hazard Management (FEHM) means actions, procedures, and policies used by organizations and individuals to prevent the occurrence of and or limit the explosion to unplanned fires and Explosions in wellbores or associated equipment.

Fire Triangle is a model for understanding the ingredients necessary for fire and Explosions to occur. In order to ignite and burn, a fire or Explosion requires air, fuel, and energy.

Appendix A – Applicable Legislation

The Fire and Explosion Hazard Management Practice encompasses requirements of the following legislation.

   a) Part 2 – Hazard Assessment, Elimination and Control
      • All Applicable Sections
   b) Part 10 – Fire and Explosion Hazards

2. Saskatchewan OH&S Regulations (to 2009)
   a) Part III – General Duties
      • All Applicable Sections
   b) Part XXV – Fire and Explosion Hazards
**Figure 2 – Fire Triangle**

The following diagram shows some of the different types of possible fuel, oxygen, and ignition sources typically found in the upstream oil and gas industry that have the potential to start fires or form explosive mixtures.

In most situations, by eliminating one side of this triangle, you eliminate the potential for a fire or Explosion. However, due to the dynamic nature of drilling, completions, and well-servicing operations, it is not always that straightforward.

The three elements (energy, oxygen and fuel) need to be present in the right amounts and near one another to cause a fire or Explosion. Important factors to consider include:

1. **Upper/lower explosive limits (UEL and LEL):** This is the concentration range of a flammable vapour in air that can ignite.

2. **Ignition energy:** This is the level of energy required to ignite a flammable mixture. It is affected by temperature and pressure as well as relative humidity.

   **Note:** The elimination of ignition sources should never be accepted as the sole basis of safety. The only reliable way of preventing fires and Explosions is to also eliminate or avoid the formation of flammable mixtures.

3. **Mixture of fuel sources:** Mixing compounds with different chemical properties can result in unique substances with significantly different properties than the original compounds.

   **Note:** See Section 18.4.2 of Enform IRP #18 for a detailed information on the fire triangle.
## Appendix B – CEN425 Fire and Explosion Hazard Management Form

### FIRE AND EXPLOSION HAZARD MANAGEMENT PLAN

<table>
<thead>
<tr>
<th>Description of Job Site Activities and Conditions</th>
<th>Location/LSD</th>
</tr>
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<tbody>
<tr>
<td>(Prior to controls being put into place)</td>
<td></td>
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<tr>
<th>Date</th>
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</thead>
</table>

### Fire and Explosion Hazards

- Energy/Ignition
- Oxygen/Air
- Fuels/Hydrocarbons

### Critical Risk Factors

- Identify factors that could be present:
  - Liquid hydrocarbons
  - Heat
  - Oil-based work over fluids
  - High pressure or temperature
  - Rapid pressure or temperature changes
  - Flow into closed system
  - Pre-existing trapped air
  - Mixing of products or chemicals

### Fire and Explosion Controls

Describe engineering and/or administrative controls used to remove the fire triangle and/or risk factors.

- Consider the elimination, substitution, isolation, and verification of hazardous substances that could affect the fire triangle or critical risk factors.

### Conditions

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Level of Risk</th>
<th>Required Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fire triangle does not exist</td>
<td>Improbable</td>
<td>1. Awareness for failure of barriers or controls</td>
</tr>
<tr>
<td>2. No risk factors present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Operations/conditions well understood</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Level of Risk</th>
<th>Required Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fire triangle may exist</td>
<td>Possible</td>
<td>1. Awareness for changing conditions/ingredients (and) 2. Reusable FEHM plan available on site</td>
</tr>
<tr>
<td>2. No risk factors present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Operations/conditions well understood</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Level of Risk</th>
<th>Required Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fire triangle may exist</td>
<td>Probable</td>
<td>1. Detailed, site-specific FEHM plan available on site (and) 2. Documented risk assessment available on site</td>
</tr>
<tr>
<td>2. One or more risk factors present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Operations/conditions not fully understood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Conditions NOT as supposed</td>
<td></td>
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</table>

### Emergency Controls

- Confirm each statement and monitor for change:
  - The assumptions on the presence of oxygen, energy, and fuel sources are still valid.
  - You have not encountered any anticipated critical risk factors.
  - There are no signs that the controls in place have failed.

### Training and Communication

- Workers are aware of, trained in, and can recognize fire and explosion hazards related to this operation.
- Fire and explosion prevention plan has been communicated and made available to all workers involved.
- Changes in conditions affecting the fire triangle, critical risk factors, or controls in place requires work to cease and re-assessment and re-documentation of fire and explosion hazard management.
- Emergency response plan is in place and has been communicated to all on site.

### Comments

- 

### Cenovus Participants in FEHM

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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### Comments

- 

### Cenovus Representative (Print Name) | Signature

- 

- (Notes: conditions reflect what has been observed and the required procedures are in place)

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