

## 1.0 Applicability

This practice applies to all Encana Oil & Gas (USA) Inc. (Encana) staff and service providers who work under contract for Encana at all facilities owned or operated by Encana.

## 2.0 Scope

The purpose of this practice is to establish the minimum operational requirements for flowback and sand management practices for the business units (BUs) and sub-business units (SBUs) at Encana. Based on site specific conditions, an SBU may elect to develop more comprehensive operational procedures in order to further reduce hazards and risks associated with a work location.

## 3.0 Core information and requirements

The core information and requirements of this practice include the following:

- 3.1 Restricted access requirements
- 3.2 Minimum standards for piping and equipment
- 3.3 Staffing requirement
- 3.4 Minimum operational requirements
- 3.5 Sand management
- 3.6 Flow line and equipment maintenance requirements
- 3.7 Flowback iron and vessel retirement

### 3.1 Restricted access requirements

All flowback operations shall have designated restricted areas in one of three hazard groups as per Encana's Restricted Access Standard. These include:

1. **Red Zone** High hazard area, no access unless approved by Site Manager and limited in duration. Flowback equipment that fall within the hazard group includes the wellhead and piping during pressure testing and active flowback operations. The red zone for these operations shall extend out a minimum of 25' from the wellhead and piping.
2. **Yellow Zone** Moderate hazard area, access limited to essential personnel. The yellow zone on flowback operations has been identified as the flowback separation equipment.
3. **White Zone** Limited Hazards present – no restrictions. No flowback operations have been identified that would fall within this hazard group.

## 3.2 Minimum standards for piping and equipment

### 3.2.1 Emergency shutdown system (ESD)

Completions personnel shall perform a risk assessment prior to the initiation of flowback operations to determine the need for the placement of an emergency shutdown system (ESD) within the designed configuration of the flowback piping and equipment. If the risk assessments determines that an ESD system is warranted, at a minimum, the ESD shall include either a hydraulic or pneumatic actuated surface safety valve (SSV) to be located upstream of the choke manifold in order to immediately shutdown flow in the event of a pipe leak or rupture, equipment malfunction, fire or similar emergency. The actuator of the ESD system shall be located remotely away from all pressurized piping and equipment, preferably in the direction of the site evacuation route.

### 3.2.2 Choke Manifold

During well testing and flow back operations, the choke manifold (typically consisting of two chokes) is used to regulate the flowing pressure, control the fluid from the well, and achieve a manageable flow rate before the fluid enters the processing equipment. Another purpose is to prevent critical flow across the choke. Understanding that choke manifolds can be constructed in numerous configurations using different type chokes (fixed, manually adjustable or hydraulically adjusted with remote controls) for varying conditions, each SBU shall determine the appropriate configuration for their operations and ensure that all valves and fittings associated with the manifold shall meet the requirements of API 6A & 16C.

### 3.2.3 Flowlines

Series 602 flowback iron shall be when the flowback working pressure is less than 6,000 psi for both standard and sour gas service. Series 1502 pressure rated flowback iron shall be used when the standard and sour gas flowback working pressures are below 15,000 and 10,000 psi, respectively. Connections and fittings shall consist of either hammer unions or flanges. Hammer unions shall be made up of like halves with the same pressure ratings and thread type. Many connecting threads look alike, but will fail under working conditions. Screw-pipe and fittings shall not be used as flowback iron under any circumstance. Selection of pipe, flanges, and valves used in flowback operations shall be in accordance with Encana's Specification for Piping and Valves ECA-USA-PIPG-S-001.

Flowlines shall be directed to the ground surface as soon as possible from the wellhead and from all flowback equipment and in as straight a line as possible. Unnecessary changes in the direction of flow shall be avoided.

In situations where it is impractical to lay the piping on the ground, supports shall be used to prevent undue stress on the piping and connections. The overall design configuration of a pipe support assembly is dependent on the loading and operating condition and thus requires proper engineering prior to use. Material used in the pipe support system must be compatible with the steel pipe it supports.

Examples of the different types of pipe support devices are provided is the pictures below:



(Examples of saddle-type pipe support systems)

The pipe support devices shall be spaced so as to prevent excessive sag, bending and shear stresses in the piping, with special consideration given to those piping sections where flanges, valves, etc., impose concentrated loads. Suggested maximum spacing between pipe supports is provided in Table 1 below:

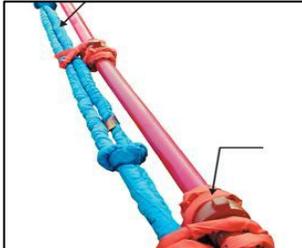
**Table 1**  
**Suggested maximum spacing between pipe supports**  
**for straight runs of standard wall and heavier pipe**

Nominal Pipe Size (inches)	Maximum Span (feet)	Nominal Pipe Size (inches)	Maximum Span (feet)
1	7	8	19
1.5	9	10	22
2	10	12	23
2.5	11	14	25
3	12	16	27
3.5	13	18	28
4	14	20	30
5	16	24	32
6	17	-	-

Values in this table do not apply where there are concentrated loads between supports, such as flanges and valves.

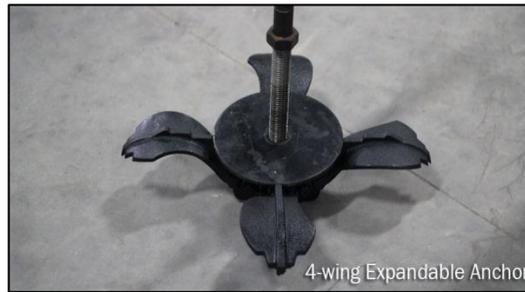
### 3.2.4 Pipe Safety Restraints & Anchors

Each connection of flowback iron and hoses should be secured using an appropriate engineered restraint system (hobbles, clamps, whipsocks, whipstops) to prevent movement should the line fail, including those connections where the direction of flow is altered (i.e. ells and tees). This system shall provide an additional level of protection for personnel and physical assets by minimizing the amount of sudden movement should there be an unexpected separation in a flowback iron while under pressure. Examples of acceptable pipe restraints are provided below,



(Acceptable pipe restraints systems for temporary piping)

Pipe anchors consisting of either deadmen type anchors or concrete blocks shall be used on all flowback iron at intervals not to exceed 40-feet. Deadmen anchors normally have three to four expandable wings with a pointed-end structure that bites into the soil for maximum grip. Deadmen type anchors shall be installed in accordance with API and IADC recommendation and applicable state and federal laws. Concrete block anchors must be designed to straddle or bolt onto the flowback iron and must be of sufficient weight to prevent movement of the anchor in case of a line failure.



(Acceptable pipe anchor systems)

It should be noted that pipe restraint and anchor examples provided above are not all inclusive and other types system may be appropriate for use. Any damaged pipe safety restraints or anchors should be taken out of service immediately.

### 3.2.5 Pressure Vessels (Test Separators and Sand Traps)

A three-phase test separator is an instrumented pressure vessel designed to efficiently separate well effluent into oil, gas and water. The three-phase test separator can operate as a stand-alone unit or in combination with the surge tank, reducing the dependency on the separation process for high-quality flow measurements.

Sand separators are used to remove solids from the well stream. The sand separator is designed to use centrifugal force to spin the sand, frac balls and other solid particles out of the well stream. Gravity causes the solids to settle at the bottom of the vessel. These are then removed by the operator as needed. Sand separators are typically located after the wellhead assembly.

All pressure vessels must contain certification plates with the following information:

- Maximum working pressure and working temperature
- Year of Manufacture
- Name of Manufacturer
- National Board number or drawing number (if available)
- Any ASME and National Board stamps
- Additional stamped certifications such as HT (Heat Treated) or RT-1 (Radiological Testing, level 1)

All test separators and sand traps must also be constructed in accordance with the Encana's Specification for Pressure Vessels ECA-USA-VESS-S-001. Fired separators must be constructed in accordance with Encana's Specification for Fired Heater Treater ECA-USA-VESS-S-002.

Pressure relief devices shall be sized according to Encana's Recommended Practice for Pressure Safety Vales ECA-USA-MECH-R-001.

### 3.2.6 Water Storage

Following hydraulic fracturing, fluids returned to the surface within a specified length of time are referred to as **flowback**. Flowback can be comprised of as little as 3% and as much as 80% or more of the total amount of water and other material used to fracture the well. Besides the original fluid used for fracturing, flowback can also

contain fluids and minerals that were in the fractured formation. The flowback water is generally collected in storage tanks or pits lined with one or more layers of plastic. These are then pumped dry, and water is usually either recycled for fracing additional wells or else trucked off site to a waste water disposal facility. Regardless of the type of storage container, provisions shall be made to ensure that adequate water storage is provided on location during taking into account overflow events that may occur during the flowback operations.

### 3.3 Staffing Requirements

Encana Completion supervisors shall ensure that there is adequate and experience personnel on location at all times to safely monitoring and operate flowback equipment during flowback operations.

### 3.4 Minimum Operational Requirements

The following section provides the minimum operations requirements for flowback operations. Each SBU shall provide specific flowback procedures for each operating area based on site specific conditions. If a decision is made by the SBU to flow the well back through a side outlet casing valve, a risk assessment shall be completed and all risks identified through the risk assessment process shall be mitigated prior to initiation of flowback operations.

#### 3.4.1 Working Alone in Remote Locations

Encana recognizes that many of our operations are located in remote or isolated areas where health and safety assistance is not readily available in the event of injury, illness, or an emergency. As a result, supervisor shall evaluate situations where employees/contractors will be working alone and develop procedures to minimize the risk to the employees/contractors. Procedures can be developed at the BU, SBU, field, site level depending which are more feasible.

Working alone procedures must include at a minimum

- a communication plan—let others know your whereabouts with time interval between check-in;
- a designee for check-ins;
- a follow-up process for missed check-ins; and
- a process for emergency response.

Higher risk activities require shorter check-in intervals. The procedures must identify an effective and reliable communications system for check-in purposes. Other factors to consider include the following:

- Plan ahead to avoid working alone or in isolation situations.
- Use the buddy system or have backup personnel on call.
- Ensure vehicle is in proper working condition.
- Carry safety or survival equipment in your vehicle and ensure supplies are replenished.
- Know your destination including maps, routes, road conditions, and GPS; and
- Know safe operating procedures for the activities or areas in which you will be working.
- In remote areas where poor cell phone coverage exists, employees and/or contractors shall be equipped with a satellite telephone capable of operating in the region of activity.

## 3.4.2 Pre-Start Safety Review (PSSR)

Prior to startup of any flowback operations, a PSSR shall be performed to ensure that the setup of the flowback equipment meets its original design, that associated piping, valves fittings, hammer unions, supports, etc. are in good condition and free of corrosion, and to re-assess any potential hazard that may exist at the site. Any deformed, corroded, or damage flowback iron observed during the visual inspection of the flowback iron will be immediately removed, marked with red paint and permanently retired from service on Encana locations. The PSSR shall also ensure that:

- Standard operating procedures and emergency procedures have been developed or updated as needed to ensure safe operation of the flowback equipment.
- Maintenance procedures and a preventative maintenance schedule have been developed or updated as needed to ensure safe operation of the equipment.
- For modified flowback procedures, the modification has been subjected to management of change review and all recommendations have been resolve or implemented before startup.
- Training of each employee involved in operating and /or maintaining the process has been completed and documented.

## 3.4.3 Pressure Testing Procedure

Piping and/or equipment failures during flowbacks can pose a serious risk to site personnel. The objective of this pressure testing procedure is to ensure that all surface equipment and piping proposed for use have been installed properly and that they are capable of functioning at their designed pressure rating without failure. As a result, all temporary equipment and piping to be placed under pressure shall be pressure tested using water as the testing medium and witnessed by the Encana supervisor responsible for the operation prior to the startup of any flowback operations. Natural gas shall not be used as a testing medium. The following procedure shall be used during pressure testing operations:

1. Before using any equipment, check its pressure rating and ensure that this pressure is not exceeded. All equipment should be clearly marked with its rated working pressure and have a valid certification stamp.
2. The Pump Operator with the Encana Supervisor shall conduct pre-test safety tour. During this tour, the flow path should be checked as correct for the operation. The status of valves should be checked as open or closed per requirements. PRVs should be installed in the system and checked to prevent over-pressurization.
3. Barriers and warning signs must be erected around the working area. These should be monitored by a designated person to prevent entry into the restricted area.
4. Pressure testing should be carried out using water as the test medium.
5. All pressure tests will be preceded by a low pressure test of ~300 psi. The pressure will then be increased slowly and smoothly in steps until the final testing pressure is reached. The standard period for all pressure tests is 10 minutes.
6. All pressure tests will be carried out with a pumping system that incorporates a tested and certified PRV set to the required test pressure plus 10%.
7. Where a flow-line requires a PRV, the valve should be isolated during the pressure testing to ensure integrity of the line being tested will be above the rating of the PRV.
8. The PRV should be set to a maximum pressure of 10% below the rating of the equipment it is to protect.

9. In order to ensure that the equipment is protected during the pressure testing, the PRV on the pump itself will also be set to a maximum of 10% below the maximum test pressure of the equipment.
10. Pressure tests shall be recorded with a calibrated chart recorder or electronic recorder of suitable range. A calibrated gauge will also be required, independent of the pressure recording device. The charts or print-outs will be signed and dated by the Pump Operator and the Encana Supervisor and retained in the well file.
11. High pressure relief valves shall be oriented in a direction to prevent exposure to personnel and equipment in the event of a discharge.
12. All high pressure pumps should be equipped with approved automatic overpressure shutdown devices. In the absence of automatic overpressure shutdown devices, pressure relief valves capable of flowrates that will adequately relieve pressure shall be used.
13. A high-pressure bleed-off line shall be included in the piping configuration and have two plug valves installed in series immediately adjacent to the main line.
14. The valve closest to the main line shall be the primary valve and shall always be fully open or fully closed. It shall be the first valve to be opened and the last valve to be closed.
15. The secondary valve shall be used as a flow control valve.
16. Bleed-off line valves shall always be opened slowly to prevent a fluid hammering effect.
17. Bleed-off lines are to be as straight as possible and correctly secured.
18. Only solid steel, high pressure pipe shall be used for bleed-off lines.
19. A successful pressure test is defined as a test resulting in no visible leaks and a minimum of 90% of maximum pressure retained for ten minutes. No sustained drips or leaks are permissible on any flanges, valves, swivel joint packing assemblies or weep holes.
20. If a pressure test is not successful, pressure shall be completely bled off the lines, the necessary repairs made with the bleed-off valves open. After repairs have been made, retest the line. Pumping shall not commence until a successful pressure test has been achieved.
21. Piping and equipment that fail the pressure test must be removed from service, clearly marked as "Reject" with paint to prevent it being mistakenly used at another site.

## Do's/Don'ts during Pressure & Leak Testing

- Do's
  - Do**—Ensure that only the following essential personnel are allowed to enter the restricted area during the test:
    - Pump Operator
    - Encana Supervisor
  - Do**—Carry out a thorough visual check of all the equipment prior to testing to ensure that all threaded connections, plugs, and caps are securely fitted and flanges are fully made up.
  - Do**—When carrying out a test, ensure that the equipment is completely full of liquid by venting all trapped air from high points, prior to raising the pressure.
  - Do**—Keep the volume of equipment under test as small as practicable.

**Do**—Test from the farthest point (e.g. frac tanks, storage tanks) first, working in stages to the Production Tree. This ensures the complete system is completely bled of air, allows low pressure testing to be completed first, and minimizes the difficulty of detecting closed and leaking valves.

**Do**—Depressurize equipment slowly after test. It may prove beneficial to bleed from multiple points.

**Do**—When pressure testing a Test Separator – check that the Daniel gate is closed, the equalizing valve is closed, but the vent is open. If the vent is closed, the gate seal cannot be checked. If the gate is leaking it is not possible to change orifice plates during the Well Test.

- Don'ts

**Don't**—Subject the equipment to rapid pressure increases or decreases.

**Don't**—Strike, hammer, or perform any work whatsoever on a pipe or vessel while it is under pressure.

**Don't**—Depend on a single valve as isolation.

**Don't**—Go near pressurized equipment when it is first subjected to maximum pressure. Let it stand for 5 minutes.

**Don't**—Stand in the line of fire (e.g. in front of bull plugs, capped lines, ell or tee connections).

**Don't**—Leave energy storage devices (e.g. accumulators), actively connected to the system while it is under test.

**Don't**—Leave relief valves isolated.

**Don't**—Drain down after a test until a vent is opened to prevent drawing a vacuum.

**Don't**—Break into the system until pressure reads atmospheric, the item has been drained or bled down and this is confirmed.

### 3.4.4 Communication Requirements

If the Completions Engineer is unavailable, the Engineer's delegate should assume full responsibility.

1. Conduct daily flowback meetings with Production and Completions personnel to address each well's current flowback plan (choke changes, etc.), additional special considerations for flowback and if/when the well is ready for turnover.
2. Ensure that the Completions Engineer (or delegate) is involved and responsible for flowback decisions.
3. Completions Engineer should inform Flowback field personnel of "what to expect" from the well (e.g. plug parts, amount of sand, undesired pressure on intermediate or surface casing, H<sub>2</sub>S, etc.).
4. Estimated Flowback Timeline is 5 to 7 days. Additional days may be required for sufficient cleanup in some circumstances before turning to Production.

### 3.5 Sand Management

As soon as a well starts producing water during flowback operations, the flowback contractor shall perform a mandatory sand separator dump every fifteen minutes throughout the entire flowback phase. If a well begins to produce medium (1-10 pounds per hour (lbs/hr) to heavy (11-20 lbs/hr) quantities of sand, more frequent sand dumps than every 15 minutes shall occur. The increased frequency of which shall be determined based on site specific conditions.

To quantify the amounts of produced sand in one hour, a container shall be placed underneath the gas buster on the open top tank to filter and catch sand debris. Water shall be drained after each sand separator dump and sand will be collected and estimated every hour. A trace of sand is considered to be anything less than 0.2 lbs/hr.

A sand quantity (lbs/hr) must be documented hourly in the Flowback Reports.

### 3.5.1 Sand Erosion Probes

Sand Probes may be used to assist in the detection of erosion in flowlines caused by abrasive sand particles. A sand probe is usually attached to a tee-type, high-pressure access fitting with a solid plug by means of a sand probe nut. The other end consists of a sealed, thin walled stainless-steel tube placed within the process stream to be exposed to the sand particles flowing through the flowback iron. As the sand impinges on the surface of the sensing element, a hole is eventually eroded through the sensing element. Once penetration has occurred, the system pressure then travels up the tube into the access fitting body and through a nipple valve to a pressure gauge assembly. The pressure gage detects that the element has been breached. If required, electronic pressure sensors can be connected to alarm systems to signal the exact moment when failure occurs.

### 3.5.2 Probe Placement

For optimum effectiveness, the sand probe should be placed in the area of maximum velocity which in most cases is located approximately ten pipe diameters or an average of two feet downstream of the choke. This will allow for maximum velocity to erode the probe and allow for turbulence to dampen and flow to be distributed even all the way across the pipe. This location should be before the first 90 degree turn in the flow line.

### 3.5.3 Continual Site Observations

The flowback contractor shall be vigilant at all time during flowback operations and continually observe the flowback iron for any and all leaks, support failures, misalignments and excessive vibration developments in piping and equipment, and fluid storage capacity provided on location.

## 3.6 Flowback Iron and Equipment Maintenance Requirements

### 3.6.1 Non-Destructive Testing (NDT) Standard for Flaw Detection

The flowback contractor shall develop a formal inspection and maintenance program for all flowback iron and equipment used for flowback operations. As part of this program, a formal schedule shall be developed by the flowback company to perform thickness testing of all flowback iron and equipment by a certified third-party inspection company at least annually or at the request of Encana to determine if the flowback iron and equipment has develop any deterioration or flaws resulting from the flowback of sand or corrosive liquids. Adequate training, examination and certification of personnel shall consist of those requirements provided in ASME *BPVC* Section V. The NDT shall be performed by one of two methods:

1. Ultrasonic Examination
2. Radiographic Examination (X-Rays)

Following the inspection, the third-party inspector shall provide a report detailing the techniques and results inspection.

### 3.6.2 Heaters/Sand Separators/Separators

In addition to the above NDT requirements above, all pressure vessels handling sand and corrosive fluid should be checked periodically to determine whether remedial work is required. Extreme cases of corrosion may require

a reduction in the rated working pressure of the vessel. Separators should be cleaned and function tested annually for the following:

- Back Pressure Valve / Regulators
- Clean Out Scrubber
- Relief Valve/ Rupture Disk
- Take Out and Check Level Controllers
- Dump Valves / Regulators
- Fluid Meters / Totalizers
- Choke (Stem, Seat, & Packing / Indicator)
- Pressure on Big Joe 75-110
- Pressure to Burner 15-20
- Pressure to Pilot 4-6
- Pressure to Little Joe 22-28
- Meter Run-Valves & Gaskets
- Clear Dump Lines From Separator
- Sample Lines
- Ball Valves/ Needle Valves
- Thermometer / Flame Arresters Cleaned
- Connections & Pipes
- Tires, Wheels, & Bearing, if trailer mounted
- Tags / Trailer Lights, if trailer mounted
- Braces and Brackets / Cracks in weld

Testing and maintenance of sand separators shall be conducted in accordance with Encana's Recommended Practice for Testing and Maintenance of Sand Separator Packages - ECA-USA-WELL-R-001.

### 3.7 Pipe and Vessel Retirement

Any flowback iron or pressure vessel shell identified during NDT to have ten percent reduction in thickness, no matter the length or location of the defect, shall immediately be removed from service and marked with red paint in order to identify the item as being defective. Flowback contractors shall develop a defective equipment management program to ensure that no defective piece of equipment can be returned to service. This program may consist of the following:

- Cutting the equipment with a torch
- Crimping the metal

Contractor shall provide documentation upon completion of destruction of the defective item to the Encana supervisor.

## 4.0 Roles and responsibilities

<b>USA Division EH&amp;S</b>	Responsible for developing, implementing, communicating, evaluating, maintaining, and improving this practice. Implementation consists of making this practice available to all staff through Encana's intranet and providing appropriate training materials and system tools for use by the business units (BUs). Evaluation consists of, at a minimum, the performance of Ethos audits within the BUs or sub-business units (SBUs) on a routine basis. Based on the results of audits and requests from staff for modifications, USA Division EH&S will make appropriate changes to the practice to maintain and improve it.
<b>BU EH&amp;S</b>	Responsible for helping implement this practice within their respective BU and SBUs.
<b>BU leadership</b>	Responsible for implementation of this practice in their BU or SBU through providing adequate resources to support the practice.
<b>BU staff</b>	Responsible for following this practice and incorporating its requirements into their work.

## 5.0 Goals, objectives, and performance measures

BU performance measures related to this practice, if any, are incorporated into Scorecards. Individual performance measures related to this practice are incorporated into High Performance Contracts.

## 6.0 Training

BU completion engineers, completion supervisors, completion coordinators, and field operations Specialists must train on this practice initially and then once every 3 years thereafter.

## 7.0 Resources

BUs shall identify, allocate, and verify appropriate resources to communicate and implement this practice.

## 8.0 Associated forms, documents, and references

### 8.1 Forms

- Flowback Pre-startup Safety Review Checklist

### 8.2 Documents/references

- Encana's Restricted Access Standard
- API Specification 6A - Specification for Wellhead and Christmas Tree Equipment - Twentieth Edition



- API Specification 16C - Specification for Choke and Kill Systems - First Edition
- Encana's Specification for Piping and Valves ECA-USA-PIPG-S-001
- Encana's Specification for Pressure Vessels ECA-USA-VESS-S-001
- Encana's Specification for Fired Heater Treater ECA-USA-VESS-S-002
- Encana's Recommended Practice for Pressure Safety Vales ECA-USA-MECH-R-001
- Recommended Practice for Testing and Maintenance of Sand Separator Packages ECA-USA-WELL-R-001.
- Encana's Specification for Wellsite Design ECA-CDN-ECA-WELL-S-01
- Encana's Recommended Practice for Wellsite Piping Erosion Inspection Triggers ECA-CDN-ECA-LOSSP-05
- ASME *BPVC* Section V – Nondestructive Examination
- ASTM E213-09 – Standard Practice for Ultrasonic Testing of Metal Pipe and Tubing