CAPP Hydraulic Fracturing Operating Practice:

WELLBORE CONSTRUCTION AND QUALITY ASSURANCE

OVERVIEW

To support CAPP's Guiding Principles for Hydraulic Fracturing, seven Operating Practices have been developed in collaboration with CAPP member companies. These Operating Practices strengthen industry's commitment to continuous performance improvement in shale gas, tight gas or tight oil development.

The Wellbore Construction and Quality Assurance Operating Practice supports the Guiding Principles: **"We will safeguard the quality and quantity of regional surface and groundwater resources, through sound wellbore construction practices, sourcing fresh water alternatives where appropriate, and recycling water for reuse as much as practical";** and **"We will continue to advance, collaborate on and communicate technologies and best practices that reduce the potential environmental risks of hydraulic fracturing."**

WHAT DOES THIS PRACTICE MEAN?

CAPP and its member companies recognize that sound wellbore design and construction is fundamental to protecting groundwater resources and to responsible oil and gas development. This practice outlines the requirements for companies to design, install and maintain wellbores. Each wellbore has steel casing that is cemented to prevent any fluids from migrating into groundwater. Wellbore design is strictly controlled by individual provincial regulators, and companies have procedures in place to ensure wellbore integrity prior to initiating hydraulic fracturing operations.

HOW WILL THIS WORK?

Under this Operating Practice, companies will demonstrate that procedures are in place to ensure proper design and installation of the wellbore, and to ensure the integrity of the wellbore prior to initiation of hydraulic fracturing. This practice includes:

- Complying with applicable regulatory requirements and using good engineering practice for wellbore design.
- Installing and cementing surface casing to surface to create a continuous cement barrier, which is assessed to ensure integrity of the wellbore.
- Designing the wellbore to withstand minimum and maximum loads anticipated during hydraulic fracturing, confirming wellbore integrity with a pressure test where possible.
- Determining the cause and developing appropriate remedial plans to restore wellbore integrity in the unlikely event that it is compromised, such as surface casing vent flow or gas migration.

TECHNICAL DESCRIPTION

The purpose of this practice is to describe minimum requirements for wellbore construction and quality assurance in shale gas, tight gas and tight oil hydraulic fracturing operations.

The objective of this practice is to enable and demonstrate conformance with the following CAPP Guiding Principles for Hydraulic Fracturing:

We will safeguard the quality and quantity of regional surface and groundwater resources, through sound wellbore construction practices, sourcing fresh water alternatives where appropriate, and recycling water for reuse as much as practical.

We will continue to advance, collaborate on and communicate technologies and best practices that reduce the potential environmental risks of hydraulic fracturing.

BACKGROUND

Hydraulic fracturing is a controlled operation that pumps a fluid and a propping agent through the wellbore to the target geological formation at high pressure in multiple intervals or stages, in order to create fractures in the formation and facilitate production of hydrocarbons. Hydraulic fracturing is a safe and proven way to develop natural gas and oil; it has been used throughout the oil and gas industry for about 60 years.

Wellbore design is regulated by the appropriate government agency. Some of the key design considerations include: protection and isolation of groundwater resources; isolation of hydrocarbon-bearing formations; and containment of all operational fluids and pressures.

Protection of groundwater starts with effective wellbore design and the proper execution of wellbore construction procedures. Every wellbore has an engineered steel casing system that is cemented externally to prevent any fluids from migrating from the wellbore to groundwater aquifers. As with all aspects of the drilling program, the casing design and cementing program conform to a well-specific, written engineered design prepared by the well operator and installed by independent, competent specialist contractors in co-ordination with the operator. The integrity of the casing and cement system can be evaluated through field inspection and wellbore logging at any point in the life of the well. Hydraulic fracturing processes are strictly regulated by various provincial government agencies.

SCOPE

This practice applies to CAPP member companies engaged in the development of shale gas, tight gas or tight oil resources through the application of hydraulic fracturing processes in Canada. While use of this practice is voluntary (subject to applicable laws and regulations), CAPP strongly encourages its use by member companies. The practice is to be utilized to ensure the effective design, installation and quality assurance of wellbores utilized in hydraulic fracturing operations.

Operational Requirements

CAPP member companies meet or exceed the following requirements for the design, installation and quality assurance of wellbores utilized in hydraulic fracturing operations:

1. Wellbore design will be conducted using good engineering practice, in strict conformance with jurisdictional regulations, and under the supervision of a competent individual.
2. Surface casing will be installed and cemented to surface. The final casing string will be appropriately centralized and cemented from the top of the target zone back into the next casing string annulus, creating a continuous cement barrier from surface to the top of the target zone.
3. In the event that cement returns are not obtained at the surface, or the cement level in the annulus drops below the next casing string, then a cement evaluation log will be run. After assessing the results, appropriate action will be taken consistent with good engineering practice and regulatory requirements to ensure the adequacy of the wellbore's integrity.
4. Wellbore must be designed to withstand the maximum burst and collapse loads anticipated during hydraulic fracturing operations. Where possible, the integrity of the wellbore should be confirmed by an appropriately designed and conducted pressure test. If the integrity of the wellbore is compromised, the cause must be identified and an appropriate remedial plan must be developed to restore wellbore integrity.
5. In the event of an identified surface vent casing flow or gas migration, the flow must be managed in accordance with jurisdictional regulatory requirements.

Performance Measures

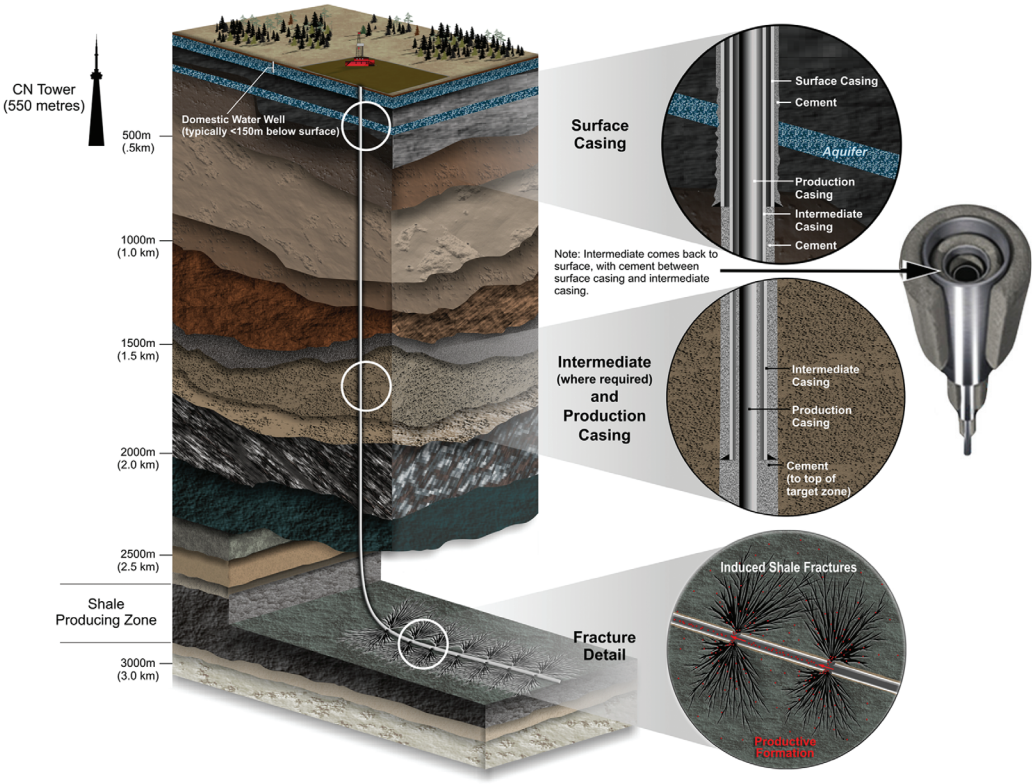
Conformance with this practice will be confirmed by demonstrating that:

- Procedures are in place to ensure the proper design and installation of the wellbore will result in the effective isolation of the producing zones from groundwater.
- Appropriate cementing practices and procedures are in place to ensure the integrity of the wellbore prior to the initiation of hydraulic fracturing operations.

Reporting Expectations

Companies are expected to make their process for wellbore construction and quality assurance publicly available, as it relates to this practice.

Typical Horizontal Shale Gas Well



Source: Encana

DEFINITIONS

Annulus: The space between the wellbore and casing, or between casing and tubing, where fluid can flow.

Casing string: An assembled length of steel pipe configured to suit a specific wellbore. The sections of pipe are connected and lowered into a wellbore, then cemented in place.

Cement evaluation log: A representation of the integrity of the cement job, especially whether the cement is adhering solidly to the outside of the casing.

Cement job: The application of a liquid slurry of cement and water to various points inside or outside the casing.

Competent individual: A competent individual is a person who is trained and experienced to perform the required duties.

Gas migration: A flow of gas that is detectable at surface outside of the outermost casing string. It refers to all possible routes for annular gas entry and propagation through and around the cement sheath.

Producing zone: The zone or formation from which natural gas or oil is produced.

Shale gas, tight gas and tight oil: For the purposes of this practice, shale gas, tight gas and tight oil refers to unconventional resources from low permeability reservoirs being developed using horizontal wells with multi-stage hydraulic fracturing.

Surface casing vent flow: The flow of gas and/or liquid or any combination out of the surface casing/casing annulus.

Wellbore: For the purposes of this practice, a wellbore is defined as the open hole that is drilled prior to the installation of casing and cement.

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2012-0034 Last updated: December 2012

CANADIAN ASSOCIATION OF PETROLEUM PRODUCERS