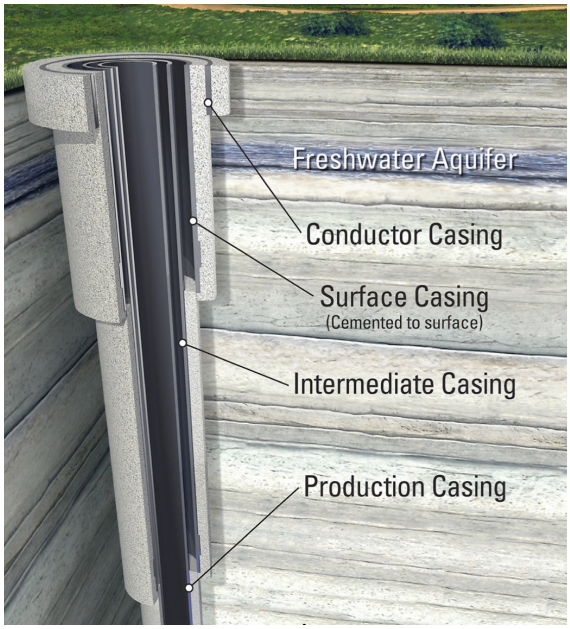
Onshore Well Integrity

ConocoPhillips

2015

A properly designed well is essential for the environmentally sound, safe production of oil and natural gas. Ensuring long-term well integrity, the ability of a well to provide effective barriers for containment of well fluids and pressures throughout the well's lifecycle, is a vital part of well design and construction. Properly designed and constructed wells safeguard workers and communities, minimize risks of leaks and spills, protect groundwater and surface water, are safe to operate and have low probability of long-term failure.

Our wells are designed to maintain well integrity throughout their lifecycle. Design considerations begin with initial site selection and end with permanent well closure. We consider region-specific geological, environmental and operational requirements for each well. While variability exists in well construction, we design every well to maintain its integrity throughout its life.



Well Design and Construction

We engineer wells for specific geology and purpose with appropriate reviews and approvals. Well casing, the steel pipe cemented into the ground at various stages during the drilling of a well, provides the primary layer of protection between the oil and gas being produced and the rock formations transected by the well. A typical well includes multiple layers of casing and cement, each designed with a specific purpose:

1 CONDUCTOR CASING is typically installed prior to bringing in the drilling rig. The conductor casing is used to stabilize the ground near the surface and to provide a conduit for drilling fluids to circulate back to the rig tanks.

2 SURFACE CASING is installed through the conductor casing and cemented in place from the surface to depths below freshwater levels as required by local regulation and company guidelines. We use air- or freshwater-based fluids to prevent contamination when drilling through freshwater zones. The primary purposes of surface casing are to isolate and protect freshwater from fluids in the wellbore and to provide a strong foundation for the wellhead and rig blowout prevention equipment.

3 INTERMEDIATE CASING is sometimes used to facilitate subsequent drilling depending on variances in wellbore stability, rock strength or formation pressure.

4 PRODUCTION CASING is installed last. The primary purposes of production casing are to provide a conduit for the production of well fluids such as oil and gas, to serve as an additional barrier to protect freshwater and to contain the fluids and pressures required for subsequent completions activities, such as hydraulic fracturing. We engineer wells for specific geology and purpose with appropriate reviews and approvals.

WELL INTEGRITY CEMENT IS CRITICAL

Cementing is the process of placing a cement sheath around casing strings in a well. It is a critical part of well construction and is a fully designed and engineered process. Cement fills the space between the well casing and the drilled wellbore, isolating different subsurface zones and providing structural support for the well. Cement is fundamental in maintaining integrity throughout the life of the well and helps protect casing from potential corrosion. ConocoPhillips follows American Petroleum Institute cement standards to ensure sound well design, construction and well integrity. Given the local variability of the subsurface environments where our company operates, cements are carefully designed to meet site specific conditions. Selected cements are laboratory tested in advance to ensure they meet well design and regulatory requirements.

Active Production

Our commitment to safe and environmentally responsible operations continues throughout the life of each well, which is typically in operation for 20 to 30 years. Our well operations meet or exceed regulatory requirements and statutes and internal technical and safety guidelines. Our internal guidelines are based upon global best practices and are designed to protect people, water, land and air over the well's life cycle.

Various types of mechanical integrity tests are used to assess well integrity and seals over the productive life of the well. Operating pressure limits are established and casing strings are monitored to ensure that well integrity concerns, such as leaks, are quickly detected and appropriately addressed. Alarms and relief systems are regularly tested, and personnel are trained to properly operate wells and onsite facilities. We maintain safe work practices to protect the environment, our employees, our contractors and the communities in which we operate and engage with local communities to understand their issues.

Well Plugging and Surface Restoration

At the end of the productive life of a well, we employ stringent well site-closure requirements to plug a well. Plugging includes setting cement plugs and/or mechanical barriers in the wellbore to eliminate potential paths to the surface and to isolate oil and natural gas from freshwater resources.

Our wells are properly closed in accordance with regulatory requirements and internal guidelines that ensure long-term environmental protection. We submit a well plugging plan for review and approval by the controlling regulatory agency. Documentation to preserve physical location, well construction and well closure details for future reference is also filed with government authorities. In the U.S., regulations have specific provisions for well plugging as well as documentation of the actual plugging operations. These documents include the depth intervals that were cemented as well as the materials used during this final stage of a well's life.

We meet our commitments to restore surface locations as close as possible to the original condition or to the owner's preference in compliance with all regulations and contractual obligations, including restoring the land to its natural contour and reseeding with native species.

Post Plugging

Maintaining well integrity throughout the life of the well is key to preventing loss of containment. Our commitment to maintaining well integrity extends throughout the plugging process. In the rare occurrence of a leak or loss of containment following plugging, we are committed to working with applicable governmental jurisdictions to determine appropriate remedial actions.

In the U.S., most states have established funding mechanisms and programs to oversee the plugging of orphaned wells and/or reclamation of abandoned sites. Orphaned wells occur when a operator is no longer in business and a well they had originally operated is found to not be plugged or plugged inadequately. Typically, operators pay a fee to the state to help fund the closure of these orphaned wells.

FREQUENTLY ASKED QUESTIONS

Are wells that are hydraulically fractured more likely to leak and contaminate freshwater resources?

No. Hydraulic fracturing is a safe and proven technique that has helped develop oil and natural gas resources for more than 60 years. We are confident in our ability to safely and responsibly develop oil and natural gas resources. We design our wells with multiple barriers to isolate and protect groundwater from hydraulic fracturing fluids and produced well fluids. Personnel at the wellsite continually monitor fluid injection rates and pressures throughout the hydraulic fracturing process to maintain well integrity.

What about the claim that eventually almost all oil and gas wells will experience compromised integrity and fail?

When designing and constructing a well, operators typically design wells with multiple layers of casing and cement, creating redundant safeguards so that the potential failure of one barrier does not result in compromised wellbore integrity. Well failure refers to the failure of any barrier element—a casing string, cement, a seal in the wellhead, etc.—within a multiple barrier system and is reported to the appropriate regulatory agency. Failure to pass a barrier test does not mean that a leak to the surrounding environment occurred or will occur. Rigorous well testing and reporting helps us identify potential problems and implement solutions to continuously provide safe operations and oversee environmental protection.

An August 2011 report from the Groundwater Protection Council examined more than 33,000 wells drilled and completed in Ohio and 187,000 wells drilled and completed in Texas. This data showed that the failure rate of one barrier within a multi-barrier well system was 0.03 percent and 0.01 percent, respectively, most failures of which occurred in the 1980s and 1990s.[1] A combination of new technologies, industry diligence, and updated government regulations will likely continue to reduce this failure rate, and when detected, operators have a variety of techniques such as remedial cement or installation of additional casing to restore well integrity.

For more information on this topic please visit: *http://www.energyindepth.org/tag/well-integrity/*

[1] Source: Groundwater Protection Council, *State Oil and Gas Agency Groundwater Investigation: And Their Role in Advancing Regulatory Reforms, A Two-State Review: Ohio and Texas* (August 2011).

For more information: www.powerincooperation.com

CS 14-1588