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The integrity of oil and gas wells

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Public concerns about oil and natural gas extraction these days inevitably turn to hydraulic fracturing, where millions of gallons of water, sand, and chemicals are pumped underground at high pressures to crack open rocks. Hydraulic fracturing often occurs a mile or more down, far from the water we drink or the air we breathe. The focus for safety and environmental stewardship should often be somewhere else—nearer the surface—emphasizing risks from spills, wastewater disposal, and the integrity of oil and natural gas wells passing through drinking-water aquifers (1⇓⇓–4). In PNAS, Ingraffea et al. (5) examine one of these factors, well integrity, across the Marcellus region of Pennsylvania, using inspection records from the state Department of Environmental Protection (DEP).

In a technical sense, “well integrity” refers to the zonal isolation of liquids and gases from the target formation or from intermediate layers through which the well passes. In a practical sense, it means that a well doesn’t leak. Drilling companies emphasize well integrity because a faulty well is expensive to repair and, in the rarest of cases, costs lives, as in the *Deepwater Horizon* disaster in the Gulf of Mexico. Drillers use steel casing (pipes), cement between nested casings and between the outside casing and rock wall, and mechanical devices to keep fluids inside the well.

Faulty casing and cementing cause most well integrity problems. Steel casing can leak at the connections or corrode from acids. Cement can deteriorate with time too, but leaks also happen when cement shrinks, develops cracks or channels, or is lost into the surrounding rock when applied. If integrity fails, gases and liquids can leak out of the casing or, just as importantly, move into, up, and out of the well through faulty cement between the casing and the rock wall.

Rates of Well Failure

Much is …

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