



NZ resource sector position paper: Fraccing

Introduction

A recent anti-resource campaign in New Zealand has focused on hydraulic fracturing – also known as fracture stimulation, “fracking” or “fraccing” - of gas-bearing rock strata and coal seams. This campaign has conflated legitimate concerns with misleading information. The NZ resource sector identified the need to assess the issues in a New Zealand context and present a fact sheet to inform stakeholders and a broader audience.

In this paper, we explain what fraccing is, the New Zealand context for fraccing, why we do it, how we do it, and how the environmental, and health and safety risks are managed. Frequently Asked Questions (FAQs) are appended, as is a short analysis of the Gaslands documentary, which has originated recent concern.

Fraccing is not a new technique. It has been used for more than 50 years around the world and the processes, materials and chemicals used in fraccing have evolved and advanced over time.

In New Zealand, there have been less than 20 fraccing operations in our history of petroleum development. No environmental issues have arisen from any of these operations.

Fraccing is largely used in CSG here in New Zealand, but from time to time there may be fraccing of a new natural gas well, either onshore or near shore.

What is fraccing?

Fraccing is, basically, the creation of fissures in targeted rock formations deep underground. An emulsion, or mixture, of water, sand and chemical agents is pumped into the target formation. The chemical agents keep the sand in suspension in the fluid throughout the pumping process and the chemicals used in modern fraccing pose no threat to the environment. When the chemical agents break down the fluids are removed and the sand remains to keep the fissures open and increase the flow characteristics of the rock.

Why fraccing is done

Fraccing is mainly carried out in natural gas reservoirs, and coal-seam gas (CSG) bearing coal seams, to encourage the gas to flow more freely and thereby increase the rate of well and field recovery, and the total amount of gas recovered. In some cases, fraccing can reduce the number of wells needed to extract a resource and, less frequently, fraccing has been used in oil reservoirs.

Fracking is only done if economically viable. In the case of CSG, fracking of a coal seam is often necessary for encouraging the gas to flow at economic rates of extraction.

Where fracking is not done

Water table

Fracking is NOT done within or anywhere near the water table, that is to say, the layer of soil and rock holding the groundwater that interacts with surface water.

Gas reservoirs typically lie well in excess of 1000m or 1km beneath the water table. CSG reservoirs are shallower, but are still typically 100s of metres below the water table.

In the NZ gas industry, fracking, when it is done, targets strata typically between 3000m and 4000m below the surface. The shallowest operation for gas was at 1400m depth on land in South Taranaki where the water table was 300m deep.

For CSG trials in the Waikato in 2007, the fracking was done at 380m, and the water table was 60m deep.

Fracturing of rock occurs only in the desired stratum or reservoir. This is the case because the fracking fluid is contained by the steel casing in the well until the target depth is reached.

Other

Fracking is not generally used in oil extraction because there is often little effect on the rate of flow, oil being much more viscous than gas, i.e. thicker and less able to flow. It is not used in underground coal gasification (UCG).

The geology

Two aspects to gas-bearing rock strata must be understood to complete the picture on why fracking is done: *porosity*, the amount of pore space within the rock, and *permeability*, the degree to which the pores are inter-connected.

To illustrate, pumice floats because there are many empty spaces within the rock but the spaces are not connected to one another – this rock is said to be highly porous but not permeable. Imagine, on the other hand, a cone of oranges stacked high in a grocer's shop. If you pour water over the stack, it will flow easily through the oranges onto the shelf; the stack is both porous and permeable.

Some gas-bearing strata are in between. The spaces in the rock are very small and are full of gas but the gas cannot move easily on its own, even from an area of high pressure (deeply-buried rock), to low pressure (the well). By opening cracks in this rock, fracking increases the permeability of the reservoir.

How fracking is done

Pump a fluid under pressure to open up cracks in the gas-bearing rock stratum

The key input to fracking is the fracking fluid – typically 98% water and sand. In some cases, a form of petroleum, called condensate, is used instead of water.

The remaining 2% are additives to achieve various objectives: to make the fluid slippery for ease of pumping; thicker to hold the sand in suspension while cracks in the rock are being opened under pressure; to prevent fluid leaking too quickly through the reservoir; and to then thin the fluid to ease evacuation from the reservoir once fracking is completed.

A note on the additives is provided later in this paper.

Avoid loss of fracking fluid and gas

A well is drilled and lined with steel casing. That steel casing is held in place with cement, and is installed as a succession of tubular sections, each section screwed into the next.

The fracking fluid is then pumped under pressure down to the desired depth, being contained by the steel well casing until it reaches the target depth, i.e. the depth of the reservoir rock. At that depth, the casing sections are either perforated, or the casing comes to an end.

The fluids are maintained under pressure for a short period of time (minutes) determined by the design engineer. When the pressure is released some of the fracking fluid is driven by high pressure in the reservoir back up the well and is collected at the surface. These fluids are then sent to an approved disposal facility.

Most of any fracking fluid remaining in the reservoir after the initial clean-up will be returned to the surface via the well, as the well produces natural gas or CSG. This is recovered and disposed of in the same way.

A very small amount of the fracking fluid will stay underground (as does some 20–30% of the gas). This residual amount is not recoverable, mainly because at low concentrations, the effect of surface tension increases, which increases friction between the rock structure and the gas. In the same way, no matter how hard a sponge full of water is squeezed, there is always a little water that remains in the sponge.

Note on additives

Particular concern has been expressed over the composition of the additives to the fracking fluid.

For any one fracking operation, around a dozen chemicals or additives are needed for the fracking process to work. The additives are required to be named, explained, and approved by the Environmental Risk Management Authority of New Zealand (ERMA).

Information on additives is generally publicly available, e.g. on the PEPANZ web site <http://www.pepanz.org/> or from companies such as BJ Services, a New Plymouth-based firm providing fracking and related services around the globe. <http://www.bjsservices.com/>

The main chemicals for a fracking operation typically comprise:

- **A friction reducer** – for ease of pumping and evacuation of fluid
- **A natural gel** – to hold the sand in suspension

- **A gel management system** - to stabilise the gel until the sand is moved into fissures, and later weaken the gel to allow the fluid to come back up, followed by the gas
- **A clay stabiliser** - to prevent any clay minerals in the reservoir rock from expanding on contact with water and plugging the reservoir
- **A bactericide** – to prevent bacterial action underground interfering with the gel management system

The above chemicals are similar to many found in other commercial uses or in the household. For example, the natural gel is guar gum which is also used in ice cream manufacture, the gel breaker is similar to chemicals used in household detergents, and the bactericide is similar to those in household sprays and hand-wash soaps.

In the concentrations used, the fracturing chemicals are non-toxic to humans, and many are biodegradable. That's not an invitation to drink this any more than one would drink dish water.

Additives used in modern fracturing no longer include BTEX, an acronym for benzene, toluene, ethylbenzene, and xylenes - compounds which can have harmful effects on the human central nervous system.

Management of health & safety, and environmental issues

In New Zealand, we have strong environmental laws. All aspects of fracturing are subject to Resource Management Act consents on land and within the marine and coastal area out to the 22km limit. Environmental legislation is being planned for the Exclusive Economic Zone (EEZ) to cover the gap out to the 370km limit (an initiative the NZ resource sector supports). That said, fracturing is unlikely to be carried out within the EEZ because the costs of transporting materials increase with distance from land.

Other matters are covered in legislation such as the Health and Safety in Employment Act 2002 and the Hazardous Substances and New Organisms Act 1996.

All fluids and materials moving up and down the well are isolated from the surrounding rock by the steel/cement casing of the well.

All used fracturing fluids that return to the surface are captured in surface storage tanks and disposed of under strict conditions, for example, via reinjection into a used gas well. There is no forced evaporation of returned fracturing fluids.

Gaslands documentary: United States

To return to the origin of this paper, the "Gaslands" documentary by Josh Fox has caused concern over fracturing in New Zealand, including within the gas and coal industries.

For the record, fracturing in New Zealand is nothing like how this technology is portrayed in Gaslands.

Gaslands is controversial because of contested allegations of environmental damage (to drinking water, air quality and, ultimately, to human health), and of a cover-up (gas companies refusing to be interviewed, and authorities turning a blind eye).

- The US gas industry provided a rebuttal of Gaslands:
<http://www.energyindepth.org/2010/06/debunking-gasland/>
- Josh Fox and friends' rebuttal of the rebuttal:
http://1trickpony.cachefly.net/gas/pdf/Affirming_Gasland_Sept_2010.pdf

Within the above, there were spectacular scenes of people lighting fire to their tapwater which the US gas industry alleges had nothing to do with fracking for gas. In these cases, official investigations found that poorly-sealed water bores for the affected residents were drilled through shallow coal seams, and methane naturally occurring within the coal seams leaked from them into the drinking water. While Fox asserts that "other chemicals" were also found in the tap water, no evidence has been offered to argue that these supposed chemicals stemmed from gas drilling and fracking, or that any of the chemicals used in gas drilling or fracking contributed to poor water quality.

Be that as it may, it is more certain that air quality issues have arisen in the US as a result of some of the practices used for disposal of recovered fracking fluids, practices that are not legal in New Zealand, and which involve chemicals not used in New Zealand.

Concluding remarks

The NZ public is right to hold the NZ gas and CSG industries to account, to ensure that fracking in New Zealand is done appropriately.

Unlike other parts of the world, we believe fracking in New Zealand is done properly and carefully because we have strict laws and the industry goes to every effort to ensure that is the case.

To reinforce the foregoing, the NZ resource sector states that we have nothing to hide, and everything to gain from open dialogue with all interested parties on fracking, and on our activities generally. (An open dialogue is one in which there is a two-way conversation held in an atmosphere of mutual respect.)

Postscript

Some of the opposition to fracking appears to be part of a campaign against all fossil fuel development. We respect freedom of speech and the right of any party to express their view, but note the world we live in is highly dependent on energy, and that fossil fuels are, and for the foreseeable future will continue to be, a large part of the mix.

The oil & gas, and coal industries provide essential services and products to New Zealand. For now and the near future, it would be unthinkable for New Zealand to do without oil & gas, or coal. Of course, we must develop these resources in an environmentally-responsible way, and that includes the global response to climate change issues.

Appendix: FAQs

What about subsidence of the rock once the gas or the CSG is removed?

There is no subsidence as the rock structure beneath the ground is held together by rock to rock contact. The gas is only flowing through areas of existing pore space. As an analogy, when water is squeezed out of a sponge, the sponge remains. In any case, as gas is evacuated, it is generally replaced by deeply-buried water. Note that this water is generally saline, and is isolated from the water table, which is much closer to the surface.

What about the explosions in gas fields in the US, that could happen in NZ

Fracking has nothing to do with explosions.

If explosions do occur, for other reasons, they have to be at the surface where there is oxygen to allow gas to ignite. The industry does everything it can to minimise the risk of an explosion. But like many activities, risk can never be eliminated completely. It is a matter of reducing risk as much as possible and having systems to manage an incident. To date in New Zealand there has never been an explosion in a gas field.

What would happen if water did get contaminated

There has never been water contamination in New Zealand as a result of fracking, or an oil & gas operation generally.

In the case of a NZ fracking operation, such could only occur if the steel casing, and the cement holding it in place, happened to rupture during the fracking operation, at the depth of a groundwater aquifer, and if fracking safety systems failed to shut down. In that event, high pressure in the well would force fracking fluid into the aquifer. It is not impossible for such a chain of events to occur but it is extremely unlikely.

What would happen in a Japan-magnitude earthquake?

Nothing as a result of fracking.

A large tsunami could affect an offshore gas rig, whether or not any fracking was being done. Displacement of a coal seam in an earthquake could cause a natural release of CSG through natural cracks forming in the rock. Recall that most earthquakes occur at depths of more than 5–10km below ground, well below gas or coal reservoir zones and fracking operations.

Even if an earthquake did cause faulting across reservoir zones, the gas would escape anyway, through natural processes. Indeed, this has been a common occurrence over geological time, explaining why exploration wells are often dry – the rock structure looks good for oil or gas, but the hydrocarbons are long gone.

Could drilling cause an earthquake?

No. Earthquakes are caused by huge natural forces operating on the Earth's crust. The energy of the Earth's natural processes is vastly more than that of any well drilling. It would like comparing a digger operating on the side of a volcano with the forces unleashed in an eruption.