

Submission into : *Independent Scientific Panel Inquiry into Hydraulic Fracture Stimulation in Western Australia 2017.*

March 2018
by Humphrey Boogaerdt

Introduction

There may be an inclination to skip this introduction and go straight to the technical part of this submission, but to get the best outcome from this inquiry it needs to have a holistic view. Besides the inquiry's aim is to look at the scientific / technical aspects of hydraulic fracture stimulation for unconventional gas (here after referred to just as fracking) philosophical, societal, political and economic aspects have to be looked at as well, because these fracking activities, and that is true for any human activity, are not done in isolation. The impacts of the recommendations of this inquiry will have consequences for generations to come. So the issues regarding social, health and environmental problems should now be taken into account. The aim is not to create a nanny state but setup a regulatory framework to ensure a fair and liveable planet for us and future generations.

Arguments by pro-frackers are based on the status quo, however often their logic is not conclusive when analysing their arguments. There is acceptance that climate change is real. That means we do not live an era where the status quo regarding the environment is acceptable and desirable. As a society we are morally obliged to change the way we run the economy in order to make it sustainable now and for future generations.

The 'western' world has become in part rich due the history of colonisation based on "pillaging" with no regards for nature or inhabitants. This is unfair and not sustainable. Our economic modelling and thinking are still based on the pillage mentality. The real cost of human activity has to be calculated and included in our products, that is externalities have to be included, using methods like Full Cost Accounting (Antheaume, 2004 & 2012). Or, going even further with changing the economic system with amongst others "Doughnut Economics" (Raworth, 2017) and the "Circular Economy" (Rau & Oberhuber, 2017). In addition there may be a need for a more humane and inclusive approach to economic issues as described by Brown (2017) in her book 'Buddhist Economics : an Enlightened Approach to a dismal Science'. These new approaches to economics provide sustainable alternatives.

In 2018 it is not acceptable any more to argue that economics for a company is more important than the environment. Companies have to start paying for externalities. In Wikipedia the definition of externality is given as follows : "In economics, an **externality** is the cost or benefit that affects a party who did not choose to incur that cost or benefit. Economists often urge governments to adopt policies that 'internalize' an externality, so that costs and benefits will affect mainly parties who choose to incur them". The concept of paying for externalities is not new, in 1920 it was suggested by Arthur Pigou. Taxes raised to cover these types of costs were named after him, namely 'pigouvian taxes', a current example would be a carbon tax. Externalities are

paid for by government, funded by the taxpayer. If externalities are paid for by companies tax rated could be lower since governments do not have these costs. Is it the task of the taxpayer to pay for externalities of a company, while the company reaps the profit?

Neoliberals may see this as lefty talk but it is really about survival of the next generations like fighting climate change is a battle of surviving.

What has this to do with an inquiry into fracking? A lot, namely the question has to be asked "is fracking a technique that fits in a sustainable future?"

Even with the transition to a 100% renewable energy gas will be needed for the chemical industry, but there are plenty of conventional reserves to supply future (dwindling) demands. Modelling by Sustainable Energy Now (SEN, 2017) and others indicate that it is possible not only technically but also economically to achieve that goal. Fortunately we have a gas reservation policy in WA there will be enough gas for local demand from conventional gas fields. So fracking gas is not needed for the domestic market.

Industry in general will regularly use the word sustainability, with that they do not necessarily mean the same as an environmentalist. It is often used as greenwashing or meaning that the business sustains making profit (Schaltegger & Burritt, 2010).

Time has come to start testing of ministers, other politicians and proponents the knowledge about fracking by asking if they can explain in layman terms what fracking for unconventional gas entails.

That includes explaining what slickwater is? What the type of chemicals are used, if they are toxic or not and in what quantities? How large is the water consumption per well and where does the water come from? What is the impact on local farmers and society? What is the size of the land clearance size, access roads and traffic issues, etc. What are the risks of well failure? The answers are to be based on evidence, not on general phrases like "best practices" or "robust risk management strategies" or weasel words like "should", because then they indicate that they do not know the answer. Fact-Checked against data provided by eminent academics like Prof Tony Ingraffea. Presented ideally with diagrams, at least one basic drawing the questioned should be able to create: "sketch diagrammatically a cross section of a fracking well with distances".

If they cannot do this simple task, they should not be allowed to legislate or promote something about of which they appear to be ignorant. It is very important to ascertain if that decision makers understand the topic they are voting over.

They may say but 'experts' advised us, in principle that fine, but a basic understanding of the issue is still essential. One should not forget experts can get it also wrong with e.g. DDT and thalidomide. In other words when government agencies assess proposals they should carefully study objections that have concerns about health or environment to ascertain if they are valid concerns.

My disappointment is not necessarily about the outcome of the Barnett government Senate Inquiry into fracking. But, to me it appears that very little weight has been given to concerns, backed up by facts not just emotional comments, by e.g. Prof Ingraffea (ref 409 in the report). By the way, Ingraffea was keynote speaker at the “North American Wellbore Integrity Workshop” in Denver in Oct 2013, organised by the Petroleum Research Centre and sponsored by Schlumberger (a worldwide oil industry service company). His keynote address goes through more or less the same points as the paper was referenced in the report. When reading a paper from an academic like Ingraffea the alarm bells should start ringing and would it then not be prudent to fully investigate his claims? Who provided the mitigating evidence that Ingraffea's concerns are not real, even though his concerns are backed up by facts provided by the gas industry and governments. The answers to the concerns he raises seem to have been dealt with in the report with phrases like “industry best practices” and “robust regulations”. In reality regulations get tightened up only if “industry best practices” at a specific time did not prevent a disaster. The new regulations become best practices until the next disaster. And then the cycle starts again.

Inquiries often appear to give more weight to “evidence” by companies that are part of that industry as is clear from Barnett government inquiry, than by others that put submissions in. However this attitude is akin to for a court judge to give more weight to the “evidence” by a criminal than that of the prosecution.

In final reports, including this inquiry, there should be transparency diagrams or tables that show the disclosure of funding independence of the institution or individual expert. There are many university and research institutions that get sponsored by industry, and so their researchers could be compromised.

Risk Insurance

No gas company will ever guarantee that drilling and operating gas wells is 100% safe. And they should not, because they cannot guarantee 100% safety. UC-gas fracking wells have an even greater risk and rate of failure. There are various reasons for that, one is there are more wells drilled and with every extra well drilled there is another chance of failure and secondly they are deviated. As an analogy, ask any builder if the risk of leaks in the roof increases with the number of vents going through a roof. They will certainly confirm the more vents the more chance of sealing problems. That is exactly the same when drilling through aquifers, the more wells the more chance of leaks. Fracking wells, like any other deep well, for sure intersect one or more aquifers. Due to lack of baseline studies it is not known if the aquifers are connected or not. So if there is a contamination it easily could move into another aquifer that could be used for drinking water. As mentioned before whenever a well is drilled through an aquifer there is a chance of leakage and failure. Everyone in the gas/oil industry knows that when a reservoir, of gas, water or oil, is damaged it is damaged *forever*. With aquifers being water reservoirs, there is a social responsibility towards farmers and population in general. **Access to fresh uncontaminated water is a human right.** One of the huge problems with the shale-gas industry is the number of wells that need to be drilled, hundreds or even thousands in an area. To drill large number of wells vast quantities of water are needed. In addition fracking uses a lot of toxic chemicals that can pollute clean drinking water. This frack-water loaded with chemicals is pumped down the hole and comes back to the surface. Ask yourself where do those chemicals end up?

As part of risk assessment is to ascertain if it is worth the risk. Especially now when there are the alternatives of Renewable Energy sources. As there will be need for cooking coal for iron-ore smelting, gas will be needed for chemical industries. However there is ample conventional gas that full fill this demand.

A major consideration of everything we do is the '*risk factor*'. Mostly risks are so small that we do not have to worry about them. But in relation to fracking risks are much higher and we have to worry about them.

The outcome of the Barnett government parliamentary inquiry into fracking was that any concerns were null and void and risks could be managed. The industry obviously agrees with this statement, because that clears the way for the use of fracking techniques. If the gas industry is so sure that fracking for UC-gas is basically risk free they should not have any problem accepting the following proposal to transparently show the public that fracking is safe. Namely, obtaining an insurance policy that covers all environmental damage for the production life of the well, plus 25 years beyond that point in time as a safety margin. If reputable insurance companies come to the conclusion that fracking for UC-gas is safe and therefore a low risk to the insurance company, the premium will be so small that it will have no impact on the gas company's profit margin. However, if the insurance companies determine that fracking is very risky business, very high premiums will be charged. If the gas companies do not take up this suggestion, then by default it means that fracking for UC-gas is inherently unsafe and environmentally damaging.

The risk associated with fracking which is very high. In my view a good way, as mentioned before, to assess the financial risk is to get insurance companies to have a look at fracking. Here some points for assessment :

- The time frame should span at least 25 years after decommissioning the well. Doing it only for the life of the production is not acceptable since many problem starts after the wells are decommissioned and by that time many companies may have gone broke.
- Health impacts on people living in close proximity or down stream or getting water from the same aquifer. The impacts could be noise, light or smells.
- Environmental impact on landscape and aquifers.
- Rehabilitation of sites.

It will be a difficult task to get gas companies to voluntary take out Fracking-Insurance, however the government could for a start with commissioning the insurance industry to conduct a pilot study of which the results are transparently published. The terms of reference to be publicly advertised, can be commented on and should include all the concerns by opponents of this practice. This would be a really good commercial test if the benefits of fracking weigh out the risk.

Technical

The technical information of this submission of the UC-gas is mainly based on information from

the USA, but there is absolutely no evidence that the situation in Australia would be any different. The oil and gas industry and markets are multinational and global. Geology in the USA and Australia are based on the same properties, so problems are the same.

The gas industry has us to believe that the situation in WA is different from elsewhere in the world. If that would be the case why does the gas industry use the same exploration methods and production methods and equipment as elsewhere in the world?

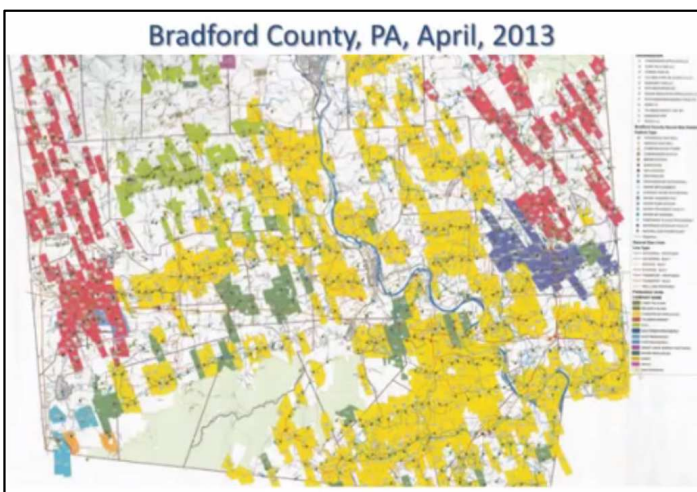
Frack Technology

The UC-gas industry tends to say that fracking has been around for more than 60 years. That is correct for conventional wells; however the fracking for UC-gas exists only since early 2000s with the advent of introduction of slickwater and horizontal drilling techniques. These latter techniques are a real cause of problems and concerns.

Fracking Coverage

In conventional reservoirs gas can flow for many square kilometers through the rock to the well. To extract gas from low permeable rocks artificial pass-ways for the gas flow have to be created this is done by fracking. In UC-gas reservoirs the gas flows only over a very small areas (square meters) and therefore the whole layers have to be fracked.

The gas industry has us to believe that it is different elsewhere. If that is the case why does this industry us the same methods and production procedures and equipment as elsewhere in the world



Lateral run at right angles to joints to get max flow.
 8 – 10 wells /sq mile. Each pad to drain 80 surface acres. Laterals 1-2 miles long.
 Each well cost \$5 – 10 million. Conventional well only 1 acre per pad.

Having 40,000hp engines (roughly equivalent to 100 road-train truck engines) for pumping running 24/7 for months means fracking is a “**Heavy Industry**”. So frack sites are Heavy Industry sites and question about these are :

- What is the fuel consumption and the related convoys of fuel trucks?
- How much air pollution they create?
- How much noise pollution?
- How much light pollution?

Water

Water usage in conventional well <10,000 gallon. Because UC-gas holes (vertical + horizontal) are much longer they need much more frack fluid. UC-gas drilling need 100 times more than conventional, millions gallons frack fluid used in UC-gas exploration. Also because the much longer distances a much higher pump pressures needed. Due to the longer pumping distances the water has to be lubricated to overcome friction when pumping down the well. This is called “Slickwater”.

Every time a well is drilled through an aquifer there is a risk of leakage. Analogy vents through a roof, the more vents through a roof the more change of leakage. Ask any builder and they will confirm.

Most companies say when well is going in production, that it is “produced water” and not “flowback fluid” any more. Because different terminologies different regulations are often in place and may not be required to be tested. But likely still contains lots of nasties.

Baseline studies are essential and to be carried out before any exploration starts. They would form the basis for comparison for contamination determinations during and after exploration. Currently no baseline studies are carried out which is real omissions.

Fault Stresses

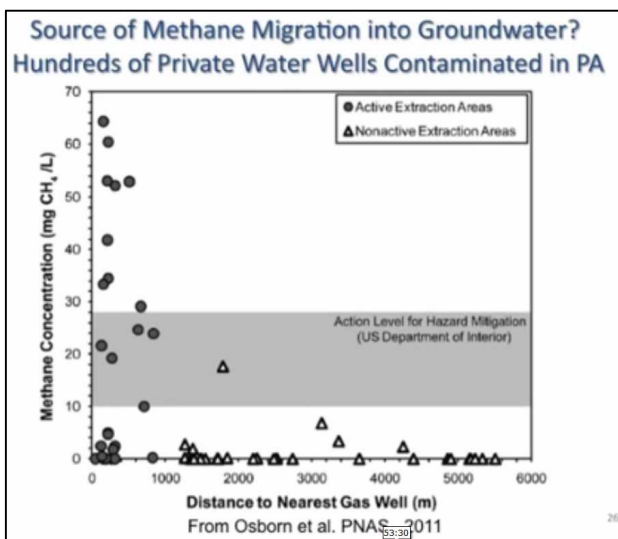
Mullen’s (2017) report provides a screening level of risk assessment to determine whether deep aquifers are likely to be compromised as a result of shale gas mining on the Cadda Terrace in WA where the Woodada gasfield is located. Fault slips can be associated with hydrocarbon leakage into overlying formations which include aquifers. Significant volumes of gas are leaking pre-development into most aquifers at Woodada. At hydraulic fracture stimulation pressure the proportion of critically stressed faults increases. The worst case scenario is for uncemented faults at the lower limit of normal stress. In this case, faults at all orientations and most dips are at risk of slipping.

The risks described by Mullen are not properly assessed by the gas companies and it appears a lack of data at the Dep Mines. The research was done in a smallish existing gas field but the methods and concerns are applicable anywhere in the world and at any scale.

Leak & Gas Emissions

The UC-gas industry says that faulty wells are a rare phenomenon. The reality is that gas migration from Faulty Wells is a well-known, chronic problem with expected rate of occurrence. Leaking wells have been reported since the early 1900s and they can be onshore, offshore, shale-gas, oil, geothermal and water wells. Whenever punching a hole through a barrier there is a chance that the seal will leak. The problem is unresponsive to tough regulations. See analogy above

In the USA 2-6% gas leaks in to atmosphere from all gas wells (conventional + UG). This is a well documented fact. Industry publishes its own statistics. Below a chart by Schlumberger.



With leaking wells if gas does not end up in the water it will end up in the atmosphere.

Industry quotes often that increased number of casings make it seal better. However, number of casings is not important. Main issue is always the outer cement, that seals the outer-casing with the surrounding rock which is not straight. Also one cement type is used to seal many types of rocks over 1000's ft.

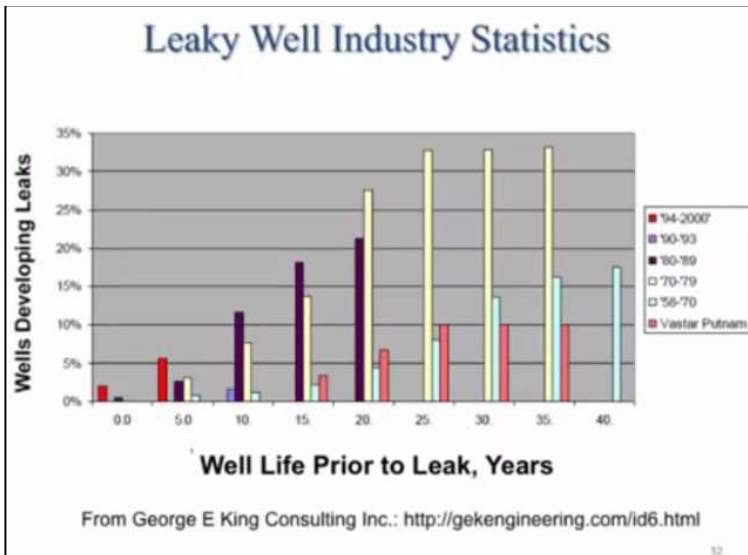
Watson & Bachu (2009, SPE 16817) researched 340,000 wells in USA. It is reported that 70%

deviated wells leak. It is much more difficult to cement a deviated well. UC-gas wells are by definition deviated.

Isn't the onus on the gas companies to proof that their procedures are safe.

For how long are gas companies responsible for old bores? They should be responsible for at least 25 years after decommissioning. Most of those companies will not exist by then, so the only way to ensure money is available for remedies is pay a bond or get insurance.

The arguments that the deposits are deep in WA is another worry. Because the deeper the reservoir the more aquifers above it it will intersect every time to reach the target. Every time an aquifer is intersected there is a sealing problem. In addition many aquifers are connected or at least not enough baseline studies have been conducted to proof otherwise.



gekengineering.com/id6.html

NOTE : Most papers written on these subjects, even with the Society Petroleum Engineers (SPE) logo on it are **NOT** peer-reviewed, they will tell this in the fineprint.

Gas (methane) has a Daunting Climate Footprint

Large-Scale Shale Gas/Oil Production Creates 3 Major Climate Problems

- Produces CO₂ when it is burned
- Methane, CH₄, purposefully vented and leaked:
 - During drilling
 - During initial frac fluid flow-back period
 - Continuously at the pad site via leaking wells
 - During liquid unloading
 - During gas processing
 - During transmission, storage, and distribution
- Produces black carbon, BC, (soot) during flaring and processing

Upstream/Midstream Methane Emission Measurements are Coming in Very High

Uinta Basin, Utah:

Up to 9% of total production

Nature 493, 12 (03 January 2013) doi:10.1038/493012a

Denver–Julesburg Basin, Colorado:

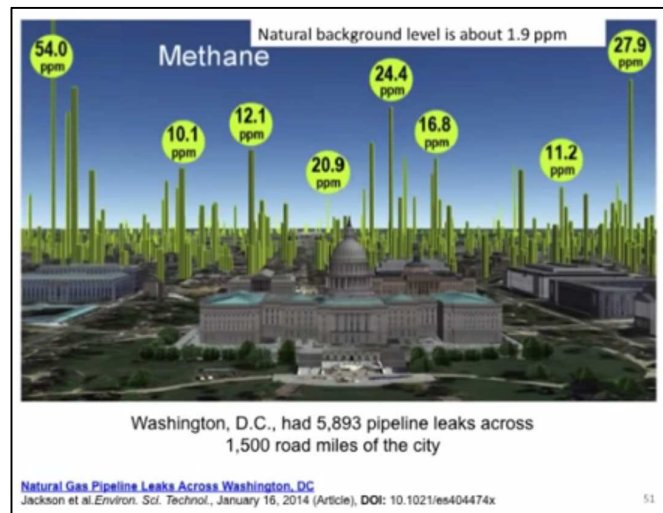
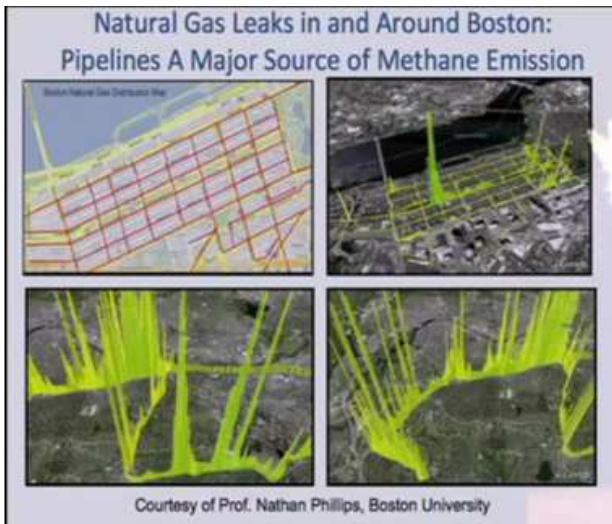
2.3% to 7% of total production

Pétron, G. *et al.* *J. Geophys. Res.* 117, D04304 (2012)

Note: Howarth, Santoro, Ingraffea predicted

TOTAL (UPSTREAM/MIDSTREAM/DOWNSTREAM) emission range of 3.6% to 7.9%.

Climatic Change Letters, 2011



Not good for atmosphere. Need to wean off gas.

The necessary process of flaring for safety reasons has to re-assessed. The amount of gas to be flared should be just enough to keep the 'pilot light' going like in a gas hotwater system. Technically it should be easy to establish how much gas is needed for this safety pilot-light. Any gas more than the required for the pilot-light royalties should be paid on. The reasoning behind this is twofold. Firstly emissions need to be kept to a minimum. Secondly the companies are wasting a public resource for which they are not paying. This is the "pillage" attitude as mentioned before. Royalties are not a tax, they are a payment for a publicly owned resource. Analogy is a coffee shop owner paying for their resource, 'the coffee bean'. So the gas companies pay the owner of the gas for that resource. Now in this case the owner of the gas is the WA State.

Economics of UC-Gas

The majority of UC-gas companies have extraordinary high levels of debt. When gas prices drop ungeared companies can just plug the well and wait for better times. However the highly geared UC-gas companies have to keep producing to create cashflow in order to service their debt. For majors like BHP Billiton that paid \$4billion for Chesapeake assets and 18months later writes it down \$2billion. Former CEO of Shell, Vossler, said in a speech for Financial Times in UK his greatest regret is the investments in shale assets.

Data sourced from US Bureau of Labour Statistics show that in 2011 oil & gas created 181,000 direct industry jobs while renewables 183,000. Oil industry does not like this and therefore have many ads to let people believe they create so many jobs. When looking at number direct jobs employed per kW the renewable energy (only wind, solar and thermal) it shows that renewable energy creates more direct industry jobs. The UC-Gas industry tells you often that they create large number of jobs. However the figures the gas industry often quotes are based on economic models. Use direct industry jobs and then apply a multiplier to get all jobs direct and indirect jobs. From economics101 : you can reverse engineer any economic model so that it exactly say what you want it to say. Study by Penn State Uni that it only created ½ jobs forecasted by industry. Ohio State Uni calculated only 20,000 jobs created in Ohio while industry forecasters 200,000. OSU estimated for PA only 20,000 jobs created which is half of Penn State's estimate. Job losses are never mentioned by the UC-gas industry. Due to their activities jobs in eg tourism,

organic farming. Are lost because these activities gas industry. This is not dissimilar to the promotion of the Adani Coalmine in Queensland, when they only talk about potential job gains. Never about the resulting job losses in agriculture and tourism.

On average Conventional gas recovery 70%, however with UC-gas the recovery drops down to below 10%. This means that more than 90% is left behind or wasted in the production process. In addition as with shale oil, UC-gas is more expensive to extract. In the early old days one unit of energy was needed to produce 100 units of oil. For today's conventional oil it is 1 unit energy needed for 11 unit oil energy. For shale oil the ratio is gone down to 1 to <5. Soon it is not worth extracting because net energy getting gain is nearing zero. Not a very responsible way of using natural resources.

The original forecasts about the Barnett Shale, USA, that it would be an economic powerhouse for 40 - 50 yrs. However the average well depletion 7 years and 857 depleted by 5 years. In Denton county , Texas, 58% increase in number wells and 28% decrease in decline revenue. Industry will say drop revenue due to drop gas price. But when doing numbers that argument does not stack up.

The UC-gas industry is transporting a lot of equipment and materials to and from the sites. This is done over public roads. Data from the USA shows that road damage costs outstrip the state revenue generated by the UC-gas companies. Some examples : Texas: revenue \$3.6B, road damage \$4B; North Dakota : revenue \$3.3B, damage \$7B; Pennsylvania : revenue \$204M, damage \$3.5B; Arkansas : revenue \$182M, damage \$4.5B.

So what the gas companies are doing is :

**Privatising the Profits and
Socialising the Losses**

Terminology :

Gas Leaking :

- = gas migration
- = loss zonal isolation
- = sustained annulus flow
- = sustained casing pressure
- = sustained casing vent flow
- = well bore integrity

Disclosure

PaYUng Contracting is an independent consultancy with no links to fossil fuel or insurance industry.

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- **Marcellus Shale Exposed** (Bethlehem, PA; March 2012)
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Addendum to Submission into : *Independent Scientific Panel Inquiry into Hydraulic Fracture Stimulation in Western Australia 2017.*¹

March 2018
by Humphrey Boogaardt

Future Need for Gas

In the Netherlands the government announced that from 2020 new building developments can only be connected to electricity network, gas connections will be forbidden. The reasons are to move away from fossil fuels in order to achieve the Paris Agreement targets.

As mentioned in my submission the future need for gas will be lower when households and commerce move to renewable energy based electricity. The savings for households are they will need to pay only for connection to electricity grid and not having to pay for gas connection.

Fault Stresses & Water

The earthquakes that are shaking and have shaken the northern province of Groningen in the Netherlands are caused by gas extraction (SodM, 2017). When earthquakes occur there is movement along new faults or along extensions of existing faults or reopening of existing faults. This means that the seals that gas companies rely on to stop movement of gas could be broken or new pathways have formed. In WA we do not have the population density in the areas of proposed fracking, as in The Netherlands even in the less populated area of Groningen where 100,000 people put in a damage claim (NOS, 2016). However when there is movement it also means that conduits could be created or reactivated between aquifers. This could result in flow of saline water into freshwater aquifers. In addition the chance of natural gas (the potent Green House Gas methane) to contaminate aquifers and / or escape to the surface are greatly increased. It would be nearly impossible for gas companies to predict where the “new faults” will occur in order to take preventative measures. Gas extraction will change the stress fields that control the gas reservoirs. As explained by Mullen (2017) these changes could have grave consequences.

The Staatstoezicht op de Mijnen (Dutch Government Authority regulating mining activities) (Sodm, 2017) wants gas extraction down to 12 billion m³, 50% lower than current levels. The aim is to reduce it to 0% in years to come. They say lowering the amount of acceptable extraction to conservative level because **they know still so little about the relationship of gas extraction and earthquakes**. SodM states this after monitoring this gas field since the 1960s when it went into production.

The Dutch State made it clear that to demonstrate damage caused by earthquakes residents themselves do not have to go to court to prove that earthquake damage is the result of gas

¹ Because travels overseas I sent in my submission before departing. Now being in The Netherlands the news is full of earthquakes caused by gas extraction, ban on fracking and the government’s responses. That is the reason for this addendum to my submission.

extraction. *In the area there is always the suspicion that earthquake damage is the result of gas extraction. Unless the NAM² can demonstrate that there is another cause* (Rijksoverheid, 2016).

Ban on Unconventional Gas Exploitation

There was a moratorium in the Netherlands for exploration of unconventional gas. Just now in February 2018 the minister for the economy announced that the practice would be banned. He told parliament that “Shalegas exploration was not an option any more for the Netherlands, because of the dangers to the environment and groundwater”.³

Conclusion

From the above it is clear that the WA government has to be extra cautious about any gas exploitation but unconventional gas exploitation in particular and therefore should ban unconventional gas exploitation. The argument that circumstances in the Netherlands are so different than in Australia is a lie. If it was true the gas companies would use totally different methods for exploration and exploitation in Australia and that is NOT the case.

Disclosure

PaYUng Contracting is an independent consultancy with no links to fossil fuel or insurance industry.

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2 NAM = Nederlandse Aardolie Maatschappij a 50-50 joint venture between Shell and ExxonMobil since 1947.

3 It should be noted that the Netherlands’ state made about ½ Trillion dollars from gas over this period and continue making money. So a ban has an impact on the state’s bottom line but they know it is necessary to wind back gas exploitation.

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Addendum #2 to Submission into : *Independent Scientific Panel Inquiry into Hydraulic Fracture Stimulation in Western Australia 2017.*

March 2018
by Humphrey Boogaerd

The Petroleum Association of Australia (PESA) have sent their members a proforma for them to sign as a submission “Independent Scientific Panel Inquiry into Hydraulic Fracture Stimulation in Western Australia 2017”. There are some issues in what they have written that need some explanation.

PESA :

As you have noted in your Background and Issues Paper, fracking of wells in WA is nothing new! Just as fracking is not a 'new' process. Over the last 65 years (since 1949) over 2 million wells have been fracked. Most have occurred in North America. Given this has occurred for over 65 year in the most litigious country on the planet, there has not been floods of lawsuits over this period, and given the anti fracking positions from some so called NGOs in North America and here in Australia any evidence of such cases would be at the top of their claims as justification for shutting down fracking all together. Indeed, racking has been used in California during its recent drought to frack water bearing sands to increase water from bores to provide water for livestock, all without any environmental damage or impacts on animal or human health.

Reply 1 :

The inquiry is in the use of "fracking for unconventional-gas" which has only been around since the invention of slickwater since around 2000. Fracking in conventional wells is not questioned and indeed used for many years in the oil & gas industry as well as for water and geothermal wells. The fact that a process is acceptable for one application does not automatically mean it is suitable for another. In conventional wells fracking occurs only over a short distance with not so many chemicals and water used. While fracking for unconventional-gas is over large distances, using enormous amounts of chemicals and water.

Reply 2 :

PESA basically states that you can do anything unless the courts have told you otherwise. This means an attitude that a business does not need to look after the environment and health, and does not believe it needs a 'social licence' to operate.

PESA :

Prior to the Hawke Report 2014, The Australian Council of Learned Academies (ACOLA) Report "Engineering Energy: Unconventional Gas Production A Study of Shale Gas in Australia" 2013, found that with appropriate safeguards in place shale gas (unconventional) with the use of fracking represents no greater risk than conventional gas. Although certain regulatory oversight needs to be maintained and adhered to maintain a risk profile which is acceptable and as low as practical (ALARP).

Reply :

There is ample evidence from the oil & gas industry itself that deviated wells have a greater risk of leaking. By definition all unconventional gas wells are deviated. Watson & Bachu (2009, Society Petroleum Engineers 16817) researched 340,000 wells in USA. It is reported that 70% deviated wells leak. It is much more difficult to cement a deviated well. Multinational Schlumberger organises conferences about the problems with leaking gas wells, so indicating that there are problems with well sealing are large enough to warrant conferences.

PESA :

The UK had a very rigorous inquiry carried out by the Royal Society and the Royal Academy of Engineering specifically to do a report on hydraulic fracture stimulation and shale gas. Professor Sir Mark Walport UK Chief Scientist gave a speech "There are really 3 science and engineering concerns about hydraulic fracturing (fracking). And what the science and the engineering tells you is that this is a drilling technology and no drilling technology is completely risk- free. But if it is done well, if it is engineered well, if it is governed well, then it is as safe as any other form of drilling, recognising that there is no 'free lunch', there is nothing that is completely risk-free."

Reply 2 :

In the last sentence of the above quoted speech the words **if** and **then** are used. That is an admission that a lot can go wrong. With PESA's attitude towards the social licence of their industry those word are not ensuring and comforting, they are actually very worrisome.

PESA :

As such, I request the that The Panel rely upon the facts and the science and allow common sense to prevail in its deliberations to recommend that drilling for unconventional gas and oil and the use of fracking in WA can be as safe as any other drilling activity, providing the regulatory oversight is robust, pragmatic and adhered to.

Reply 2 :

PESA asks the Inquiry to "allow common sense to prevail", that is an emotional plea which should not be part of the inquiry's deliberations.

We propose a total ban on fracking for unconventional gas in WA, based on evidence and arguments provided in my submission documents (Submission_Independent-Scientific-Panel-Inquiry-Hydraulic-Fracture-Stimulation-WA-2017_Boogaerd_2018_pdf.pdf, Submission-Addendum_Independent-Scientific-Panel-Inquiry-Hydraulic-Fracture-Stimulation-WA-2017_Boogaerd_2018_pdf.pdf, Submission-Addendum-#2_Independent-Scientific-Panel-Inquiry-Hydraulic-Fracture-Stimulation-WA-2017_Boogaerd_2018_pdf.pdf).

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