Schlumberger

Level 5, 256 St. Georges Terrace
Perth, Western Australia 6000

31 May 2014

The Commissioner
Hydraulic Fracturing Inquiry
GPO Box 4396
Darwin NT 0801

By email: HydraulicFracturingInquiry@nt.gov.au

Dear Mr. Commissioner

Schlumberger is pleased to have the opportunity to participate in the Territory's inquiry into hydraulic fracturing for unconventional resources.

Schlumberger is a member of the Australian Petroleum Production and Exploration Association (APPEA) and while, at the time of this submission, we have not had an opportunity to review their submission we will review and comment where Schlumberger has additional thoughts or expertise to contribute.

1. About Schlumberger

Schlumberger Limited was established in 1927 and today is the largest oilfield service company, supplying technology, project management and information solutions that optimizes performances for customers within the oil and gas industry.

Reflecting our belief that diversity spurs creativity, collaboration, and understanding of customers' needs, Schlumberger employs approximately 123,000 people representing over 140 nationalities and working in more than 85 countries. Our employees are committed to working with our customers to create the highest level of added value. Knowledge communities and expert groups within our organization enable teamwork and knowledge sharing unencumbered by geographic boundaries.

Globally, Schlumberger has performed hundreds of thousands of hydraulic fracturing treatments over the past 60 years. Today, hydraulic fracturing is a key component in the successful development of unconventional resources globally, providing energy security to many nations.

With 125 research and engineering facilities worldwide, Schlumberger places strong emphasis on developing innovative technology that adds value for our customers. In 2013, we invested $1.17 billion in Research & Engineering. Developments in hydraulic fracturing technology have brought forth increasing operational efficiency, improvements in reservoir performance and of course a reduction in footprint of our activity. Schlumberger is

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committed to ensuring that hydraulic fracturing operations in the Northern Territory are performed in the most environmentally responsible manner possible.

Schlumberger Australia Pty Ltd has been operating in Australia since 1964 and currently employs over 1,000 people in country. Schlumberger Australia has offices and operating bases in various locations within Australia: Perth, Melbourne, Brisbane, Karratha, Sale, Darwin, Chinchilla, Roma, Adelaide and Moomba. Schlumberger Australia offers a comprehensive portfolio of services to our customers including Seismic, Wireline, Directional Drilling, Logging-While-Drilling, Cementing, Fracturing, Coiled Tubing, Sand Management, Completions, Reservoir Monitoring, Flow Assurance, Artificial Lift Systems, Perforating, Surface Well Testing, Slickline, Mud Logging, Software Solutions, Data & Consulting Services, Water Services and Carbon Services.

Schlumberger Australia spends nearly $400 million annually with Australian vendors.

Schlumberger Australia has successfully completed over 500 stimulation treatments in three different states, including the completion of the first ever three horizontal multistage fractured wells in the remote region of the Georgina Basin. The Georgina Basin campaign lasted over 2 months, consuming over 1,000 man hours and performing a health, safety and environmentally incident free and successful campaign for our client.

Schlumberger has recently received Australian specific accolades including:

- 2012 Santos CEO Award for Technical Excellence and Best Overall Performance awarded to the Frac Team
- Record for most hydraulic fracturing stages completed in a vertical well in one day in Australia
- Record for most hydraulic fracturing stages completed in a horizontal well in Australia

2. Overview of Unconventional Gas

Hydrocarbons from shale were first commercially produced in 1821 and from the 1860s through the 1920s gas was produced from shallow, low-pressure, naturally fractured shales in the eastern portion of the United States. However, today's "shale revolution" did not begin until 1985. That is when the first model for economically viable production from the Barnett Shale was developed. It took nearly 20 years and hundreds of wells to find the right formula, based on two transformative technologies: horizontal drilling and multistage hydraulic fracturing.

Without these two technologies the "shale revolution" in the United States simply would not have occurred. In order for extremely low permeability shales to produce hydrocarbons at an economic rate, a large volume of rock must be exposed to a pressure drop. Hydraulic fracturing is the most effective technique ever developed to create the millions of square meters of shale surface area that can be exposed to a pressure drop in an efficient, cost

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effective manner. Horizontal wells allow us to create multiple hydraulic fractures, thus dramatically increasing this surface area, compared to what can be achieved from a single well.

Early combinations of horizontal drilling and hydraulic fracturing were not always successful economically. To improve shale economics, well operators and oilfield service companies have focused considerable brainpower and technical resources on reducing the unit cost of production through greater operational efficiency. From a production perspective, and according to the Institute for Energy Research, the United States now has more than 200 years capacity of technically recoverable oil reserves and 110 years worth of natural gas at current rates of consumption, much of those from unconventional plays.

But the tremendous advances in minimizing environmental impact are equally impressive:

- Production gains are at an average of three times greater than wells drilled in conventional reservoirs, allowing for fewer wells to achieve similar production totals.
- Pad drilling multiple horizontal wells from a single location reduces the land usage by over 70%.
- Drilling technologies, automation, and real-time data have reduced average time to total depth from 48 days to as low as 8 days.

However, development strategies pioneered in North America may not translate well overseas and cannot be simply exported to Australia. Local infrastructure, extensive services and resources requirement, management of water and waste streams, emissions, and permitting are just a few of the concerns that have to be managed properly in order to facilitate successful and environmentally responsible development of unconventional resources.

In the exploration phase, the collection of reservoir data is critical to building a basin specific model. Tapping into our experiences in unconventional plays globally, and a thorough understanding of critical reservoir drivers, helps us to build localized models of the reservoir. In combination with local seismic data, we can identify key drivers to productivity and answer key questions in the decision making that leads up to the development phase:

- Where are the reservoir sweet spots?
- What are the mechanical stress and natural fractures?
- What portion of the target reservoir rock should a well be landed and completed?
- What is the optimal lateral length and perforation spacing?
- What will be stimulated?
- How will the reservoir rock respond to hydraulic fracturing?
- How will the reservoir produce?
- How many wells are needed and where should they be placed?

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This process has allowed us to eliminate the drilling of hundred of potentially unproductive wells, reducing resource requirements, waste and impact to the surrounding communities and environment.

3. Transparency of Fracturing Chemistry

Unconventional reservoirs require advanced stimulation techniques to produce at commercially viable rates. The process of hydraulic fracturing has proven to be the most efficient at stimulating the reservoir and recent advances in chemistry have helped to reduce the associated risks. Nonetheless, there are concerns raised by the general public as to the fate of fracturing chemistry as the process is used more broadly today.

Recognizing the need for a balance in transparency of fracturing chemistry to the public and protecting proprietary chemistry, Schlumberger developed a process for full disclosure. This process, called system-style disclosure, divulges all known chemistry pumped into a hydraulically fractured well. This is achieved by decoupling the chemical constituents from their parent products thus making reverse engineering extremely difficult. While this process does not provide total protection of our proprietary chemistries, Schlumberger is committed to minimizing the use of “trade secrets” to achieve transparency in its disclosures to the public.

Schlumberger first introduced system-style disclosures in 2010 to satisfy the first of the regulatory required disclosure rules. Over the last four years, Schlumberger has generated nearly 13,000 full disclosures intended for providing transparency to the public. From a percent mass perspective, less than 0.01% of the products that Schlumberger supplied to our clients in Q1 - 2014 were listed as “trade secret”.

Originally created to strike a balance in providing information to the public and protecting proprietary technology as part of regulatory requirement, the system-style disclosures is being used voluntarily. As an example, in 2012, in the absence of any regulatory requirement, Schlumberger provided full disclosures to a client working in the Northern Territory. The disclosures included a prejob disclosure with details around intended chemistry and a follow-up post job disclosure describing the actual chemistry and percent mass injected.

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4. Technologies to Further Minimize the Environmental Impact

Schlumberger is constantly striving to develop technologies that further minimize the environmental impact. Many of the recent advances introduced by Schlumberger were developed and commercialized specifically for their low impact features, below are a few examples:

OpenFRAC*:

First introduced in 2010, OpenFRAC was developed as a family of hydraulic fracturing products that avoided the use of certain undesired chemical constituents. Over the last four years, the chemicals that OpenFRAC avoids have been expanded to the current level. At its highest screening levels, OpenFRAC products are defined to avoid the following:

- Priority Pollutants (United States EPA Reference)
- National Primary Drinking Water Contaminants (United States EPA Reference)
- Carcinogenic, Mutagenic & Reprotoxins, Category 1A, 1B & 2 (REACH Definitions)
- Nonylphenol Ethoxylates and other Alkylphenol Ethoxylates

Today, 92% of Schlumberger's hydraulic fracturing portfolio is classified as OpenFRAC. It is our goal to continue to advance the Schlumberger hydraulic fracturing portfolio to eliminate products that do not meet the OpenFRAC standard. As with the rest of hydraulic fracturing portfolio, OpenFRAC chemistries are fully disclosed via system-style disclosure.

HiWAY*:

As mentioned earlier, the process of hydraulic fracturing is extremely efficient at stimulating reservoir rock. In 2010, Schlumberger introduced a new process for hydraulic fracturing that both improved production and reduced water and proppant requirements. HiWAY, or flow-channel fracturing, combines an in-depth reservoir knowledge, unique hydraulic fracturing chemistry and specialized surface equipment with powerful fracturing modeling software. On average, HiWAY has increased production by 20% while reducing water requirements by over 25% and proppant by nearly 40% on a per well basis. With over 24,000 fracturing treatments placed with this technology in 20 countries, HiWAY has conserved 970 million gallons of water and reduced proppant requirements by over 3 billion lbs. The reduction in water and proppant directly translates to a reduction in truck traffic on local infrastructure and has prevented 32 million lbs of CO2 emissions globally. Products used as part of the HiWAY process are fully disclosed via the system-style disclosure and meet OpenFRAC standards.

UltraMARINE*:

Today, placement of proppant into a target formation requires the use of water as a carrying medium. With multiple fracturing stages per well, the quantity of water utilized is significant. Modern chemistries have allowed the use of water sources that were previously unviable. Less than a year ago, Schlumberger introduced the first of what is envisioned to be a family of hydraulic fracturing products that are specifically designed to be utilized with alternative water sourcing. UltraMARINE is designed to use seawater as the base mix water for hydraulic fracturing. A major advantage of the approach of utilizing chemistry to use alternate water sources is that waste typically generated as a by-product of recycling water

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is minimized. Additionally, the likelihood that various industries and stakeholders are competing for the same valuable water resources is reduced. Coupling technologies like UltraMARINE with HiWAY help to greatly reduce the use of fresh water sources in the hydraulic fracturing process. UltraMARINE is fully disclosed via the system-style process and meets OpenFRAC standards.

Mangrove*:
The reservoir rock that is intended to be stimulated varies in its physical properties over even a relatively short distance. As such, wells intersecting the same reservoir rock may need specific hydraulic fracturing designs in order to achieve maximum productivity. Tapping into our extensive reservoir management and modeling expertise, Schlumberger developed a software platform intended specifically to optimize design of field, well and hydraulic fracturing stage design. Additionally, the platform allows for a continuous process improvement based off of experience that is gained from one well to another during the field development process. The use of Mangrove has proven to help improve the amount of reservoir rock effectively stimulated while minimizing the use of resources. In a recent campaign in China, Mangrove helped to increase well production three-fold while reducing water requirements by nearly 50%.

5. Protecting Groundwater

For cased hole wells, a major component of wellbore construction is cement, which supports and protects well casings and helps achieve zonal isolation. Critical to safer, environmentally sound, and profitable wells, zonal isolation is created and maintained in the wellbore by the cementing process.

The cementing process includes not only the physical process of generating oil-well quality cement but starts with proper cement design. Schlumberger uses a sophisticated cement software platform called CemCADE*. Since its commercialization three decades ago, CemCADE has continued to evolve to include components critical to achieving optimal cement placement, including drilling fluid removal, casing centralization, post-treatment evaluation and cement bond log response prediction.

Additional to the cement design and evaluation tool, various cement chemistries have been developed to work in the specific downhole conditions that may exist. Those technologies include:

- DensCRETE*: high density, low viscosity cement slurries designed for generation of high compressive strength with low permeability.
- LiteCRETE*: low density, high compressive strength cement slurries for use across low pressure formations that would otherwise require nitrified cement systems.
- FlexSEAL*: flexible expanding cement slurries designed to resist stresses encountered through the life-cycle of the well.
- FUTUR*: Self-healing cement slurries that react to close flow paths without the need for well intervention, providing long-term zonal isolation and well integrity.

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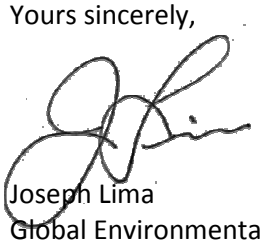
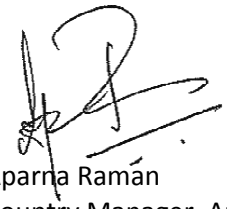
6. Further Information

Schlumberger is willing to provide further information to the inquiry and would like to provide testimony as to our experiences in associated with hydraulic fracturing. Please do not hesitate to contact me should you require any further information regarding this submission.

Yours sincerely,





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