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Hydraulic Fracturing Taskforce

GPO Box 4396, Darwin, NT 0801

By email: fracking.inquiry@nt.gov.au

Dear Hon. Justice Rachel Pepper,

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 appropriate.

Schlumberger has participated in drilling and fracturing operations in the Northern Territory on Origin Energy's Beetaloo and Amungee campaigns, and under the operatorship of Origin Energy. We would be willing to provide information on our experience under the guidance of Origin Energy and, subject to their permission, to release such data.

Schlumberger has also participated as an observer in the Darwin community consultation sessions, and as a participant in a working group in the Daly Waters community consultation session.

Our interest in this participation was to directly hear from the public and pastoral community in areas of operation, in order to improve the provision of industry information and assist in further developing relevant technical responses to community concerns. We are well positioned in terms of relevant experience and competency to provide credible input on well integrity, operational considerations for hydraulic fracture stimulation, water use, radioactive material use and handling, chemical use, risk assessments and safety management plans.

We perform hydraulic fracturing services under the operatorship of companies with licenses for drilling and related activities in the Northern Territory, and as such provide technical, safety, planning and execution advice to the operating company.

1. About Schlumberger

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

Reflecting our belief that diversity spurs creativity, collaboration, and understanding of customers' needs, Schlumberger employs more than 100,000 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 research and engineering facilities worldwide, Schlumberger places strong emphasis on developing innovative technology that adds value for our customers. 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 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, Broome, Darwin, Toowoomba, 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 \$180 million annually with Australian vendors, including over \$850,000 with indigenous suppliers

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 the client.

In 2016, Schlumberger participated in the construction of several exploration wells in Northern Territory, including Amungee NW-1H shale gas well: 11 hydraulic fracturing stages placed across ~600m of shale. Over 2.5MM lb of sand and 67,000bbl of fluid pumped by Schlumberger crew with zero spills and zero incidents.

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 hydrocarbon 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 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.

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, and differing requirements for management of water and waste streams, emissions, and permitting are just a few of the factors that have to be managed properly in order to facilitate successful and environmentally responsible development of unconventional resources.

Successful navigation of a project begins 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?

This process has allowed us to eliminate the drilling of hundreds 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 effects 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 seven years, Schlumberger has generated over 20,000 full disclosures intended for providing transparency to the public.

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.

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. A few examples include:

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 include only those that 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.

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 requirements by nearly 40% on a per well basis. With over 24,000 fracturing treatments placed with this technology in 20 countries, HiWAY has conserved over one billion gallons of water and reduced proppant requirements by over three billion lbs. The reduction in water and proppant directly translates to a reduction in truck traffic on local infrastructure and has prevented over 35 million lbs of CO2 emissions globally. Products used as part of the HiWAY process 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 conditioning water to a

suitable quality for use, is minimized. Additionally, the reliance on the highest-quality, and therefore the most 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 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 variations in 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 on 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 also 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. In addition 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.

6. Further Information

Schlumberger is willing to provide further information to the inquiry and to provide testimony as to our experiences in with hydraulic fracturing. Do not hesitate to contact me should you require any further information regarding future questions, participation or submissions.

In regards to your letter dated 28th April 2017 requesting for further information regarding estimates of water usage, requirements, waste production, storage and transport rates, including recycling and discharge, we respectfully request more time to respond to this request.

Yours sincerely



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