HALLIBURTON

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25 April 2017

Hon Justice Rachel Pepper
Chair
Hydraulic Fracturing Taskforce
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By email: fracking.inquiry@nt.gov.au

Dear Chair

Halliburton was pleased to have the opportunity to make a presentation to the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory on 10 March 2017. There were a number of matters that we took on notice during the presentation and we are pleased to provide our responses to these issues in this correspondence.

As you are aware, Halliburton is a provider of a specific suite of services to oil and gas operating companies.

Hydraulic fracturing is one particular service provided by Halliburton. As a preliminary matter, it is important to define this term - by 'hydraulic fracturing', we specifically mean the process of pumping fluids and proppant at high pressures to create fractures in the rock. In order to achieve this, a physical pathway from the wellbore to the reservoir must be available. To create a connection, any range of different techniques could be utilised such as: a wireline perforating process using explosive charges; hydrajetting on the end of coiled tubing with abrasive fluids to erode the casing; and cement or sliding sleeve technology. It is important to note that these processes are considered independent of hydraulic fracturing itself as each could also be performed in wells without any hydraulic fracturing treatments pumped.

In relation to specific questions posed at the recent hearing and which we took away on notice, we respond as follows:

How does the recycling of fluids work in a hydraulic fracturing treatment?

> Water for fracturing can come from many sources, as fracturing can be performed using non-potable saline waters. This allows the reuse (thus recycling) of produced water from fractured (and non-fractured) petroleum wells. The only treatment that is normally required is removal of suspended solids within the produced water. Electrocoagulation technology (ET) is a common solution and can destabilize and coagulate suspended colloidal matter in water. This process is most effective at treating total suspended solids, petroleum hydrocarbons, turbidity, bacteria removal and reducing iron in the produced water passed

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through the unit. After using ET, produced water can then be used as the water source for future fracturing operations in other wells.

Is depleted uranium used in the hydraulic fracturing process?

Depleted uranium is not used in hydraulic fracturing.

Radioactive sources such as Cesium-137 (Cs-137) and Americium-241/Beryllium (Am-241/Be) are used in the logging of well bores to determine the porosity and density of the formation. The gamma and neutron emissions impact the formation and give off a characteristic gamma ray that is specific to the atom which was impacted. By measuring the energy of this characteristic gamma ray, Halliburton can determine what exactly comprises the well bore and whether or not it contains hydrocarbons. These sources are removed from the borehole prior to hydraulic fracturing.

These emissions are not to be confused with contamination. The radioactive material is entirely contained within the source and is leak tested every 6 months to ensure the integrity of the source and that it does not contaminate the environment. Also, any event that may affect the physical integrity of the source requires that its use be discontinued until a valid leak test result can be provided. These results are kept on file for review by the company and regulatory bodies. When these sources are not in the wellbore performing logs, they are secured by two physical barriers and provided with 24/7 monitoring to ensure they are not accessed by untrained personnel. Halliburton also tracks the lifetime of a source from receipt to disposal to ensure these sources are kept in safe areas and do not harm the public or the environment.

Some examples of other non-logging applications using radioactive sources are: radioactive tracers for tagging and measurement of fracture placement and geometry; storage capacity monitoring for underground cavern storage; and density gauges for production volume monitoring.

If a treatment 'goes wrong', who is responsible? What is the legal chain of responsibility?

The operator is the party with the permit to drill and extract the minerals. Halliburton is a contractor hired to provide certain discrete services under the control and at the direction of the operator.

Who is legally responsible for the cement bond log (CBL), the operator or service provider? Who would be responsible for remediation in the event of contamination?

Ultimately it is an operator's decision to perform a cement bond log, and the customer is responsible for remediation if they deem the cement job unfit for isolation.

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It should be noted that multiple checks can be done before a CBL to give indications of a successful cement job. For surface casing cement jobs (that isolate shallow aquifers), such indications include, but are not limited to, cement returns to surface and simulation and matching of pressure trends during the cementing operation. For production casing jobs (that take place at much deeper depths across the production target zones generally greater than 1500 metres), cement volumes and matching of pressure trends during the cementing operation can provide additional integrity confirmation besides data from the CBL. It should also be noted that fracturing isolation in the production casing generally only requires a minimal (~ 50 metre) cement barrier, while >1000 metre of cement isolation are common above fracture targets.

Where there are multiple horizontal wells from the one wellhead is there an increased cumulative risk to the integrity of the wellhead and vertical section of that well due to the fact that it is servicing multiple wells?

Multiple lateral wells (originating from a single wellhead) are becoming increasingly common due to the reduced development costs and a reduced environmental footprint. When drilled, these would involve multiple laterals that are created from a junction that is located at a deeper vertical location, situated below any shallow aquifers. The vertical section of the well would be constructed in a similar fashion to non-multilateral wells which would comprise multiple layers of casing and cemented in place prior to any multilateral junction being installed and a lateral drilled. However, design of the wellhead and vertical section would change to incorporate the higher production flowrate and mechanical stresses that would be expected from the increase in repeated trips into and out of the vertical section of the well.

Of the approximate $60 million spent on goods and services from Australasian suppliers in 2016, what was the spend in Australia?

$35 million of the total $65 million spent on goods and services was from Australian vendors.

If a well was to go through a fault zone, is there a way to test the integrity of the surrounding rock around the drilling zone?

Geo-steering has become increasingly valuable because it utilizes complex data from different sources to identify subsurface features and detect in real time the stratigraphic position of the bit after drilling through a discontinuity (i.e. fault). Bulk density measurements and gamma ray borehole images can describe the near-well bore environment and the structural googly encountered while the use of geo-steering will identify where in the strata the bit landed on the downthrown side of the fault.

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Induced (by human activity) seismic activities are seismic events with very low magnitude and are not typically felt at the surface. Whether a seismic event is induced will depend on the local stress field in the earth. In the last few years, there has been an increase in the number and frequency of seismic events associated with oil and gas development. The great majority of this induced seismic activity is associated with the disposal (underground injection) of produced water from oil and gas operations. However, a small percentage of the events may be associated with hydraulic fracturing.

There are a number of steps operators can take to address this potential issue. During the initial mapping of the reservoir and prior to conducting fracturing operations, 3D surface and borehole seismic data along with well logs and rock cores can be used to locate and map major faults in the development field. Additionally, during fracturing operations, monitoring for seismic events helps to alert operators to seismic activity. If a seismic event is detected, operations can be paused to review and implement mitigation practices, if necessary.

I trust that this information assists the panel in their current deliberations. Please feel free to contact me should you need any further information or clarification.

Yours sincerely

Diana Grantham

Diana Grantham
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