FRAC-OUT RESPONSE PLAN

"Frac-Out" occurs when fluid pathways are developed between the bore hole and surface, due to the hydraulic pressure of drill fluid within the annulus of the bore exceeding the confining formation strength of the surrounding lithology.

Stakeholders should be reminded that Drilling Fluids are freshwater suspensions of inert clay particles. Although slippery, they are environmentally benign and in fact can be utilised to improve the water retention of poor quality soils. Control Of Substances Hazardous to Health, (COSHH), and Material Safety Data Sheets, (MSDS), are kept on site for all products involved in the drilling operation.

During the drilling of the pilot hole entry and exit curves, when the depth of cover, formation consolidation and confining strength are at a minimum, Frac-Out is most likely.

Frac-Out can also travel to surface via existing pathways, e.g. previously installed utilities, foundation piles and existing boreholes. Any Site Investigation bores sunk must be offset to the proposed drill line and sealed up on completion.

Once punch out at exit point has been achieved, the annular pressure within the bore is relieved. Frac-Out during Hole Opening and Pipe Pulling operations is therefore much less likely to occur.

There are three stages to the management of Frac-Out:

1) Prevention 2) Containment 3) Control 4) Report

Prevention

As previously noted, Frac-Out occurs when annular fluid pressures exceed formation fracture pressures. Annular fluid pressures are minimised by constant monitoring of the drilling fluid parameters.

The Drill Fluids Operator will monitor Drill Fluid density, viscosity and solids content on a regular basis, (hourly), to ensure that the fluid does not increase in viscosity, requiring additional pressure to maintain mobility.
In critical cases, viscometers will be used to measure Drill Fluid gel strength and shear strength so that Reynolds Numbers can be monitored. Filtrate can also be measured to calculate the amount of wall cake building up on the internal wall of the bore.

The Driller will monitor the Drill Fluid pressures, volumes, viscosities and densities of mud being pumped through the bore. Any increases in pump pressure will be investigated immediately to prevent the risk of pressure build up within the annulus.

The Fluids Technician will monitor active fluid tank volumes and account for any unexpected changes. The amount of fluid being taken by the additional hole volume drilled will be calculated. (The Drill Fluid is designed to allow water loss in porous formations in order to build filter cake).

The bore hole will be reamed on a regular basis to keep the annulus clear.
Rates of Penetration and circulated cuttings volumes will be monitored to ensure that drilled cuttings are being flushed from the bore and are not building up creating pressure restrictions.
Annular fluid velocity will be kept below Critical Velocity to prevent eddying and subsequent erosion caused by turbulent flow.

When drilling clay based formations, inhibitors may be used to prevent the absorption of water and subsequent swelling and sloughing of the formations.

Containment

A Frac-Watch programme will be operated at all times whilst circulating, particularly when drilling past potential pathways. Frac-Out may occur some distance from the bore path.

Prior to drilling, potential Frac-Out pathways will be identified and contingency plans put in place.

- Sand Bags/Hay Bales will be available to control drill fluid at surface.
- An excavator will be available to dig a pit to contain fluid.
- Tractor & Tanker or Vacuum trucks will be available to transfer drill fluid from the containment point back to the recycling system.
- Where frac out occurs in watercourses, a 2inch pump will be available to directly pump from the centre of the plume onto vegetative land, a minimum of 50m from the works.
- If Frac Out occurs in a riverbed, pressure relief bores may have to be drilled on the river bank. (Before any works around the watercourse can take place, this needs to be agreed with the Environmental team).
- If drilling is being undertaken in contaminated land, Frac-Out may be contaminated.
- If the fluid loss is onto the carriageway, National Highways (0300 123 5000) are to be contacted immediately or the local highway authority.

In the event that Frac-Out is experienced, the rig will **immediately** shut off the pumps and the drilling assembly will be pulled off bottom to reduce annular pressures.

Control

The freshwater based, bentonite suspension, drill fluid systems are, essentially, low viscosity grouts. In most cases, the fracture pathways will quickly seal up.
Frac-Out is likely to indicate that the bore hole requires reaming to reduce the pressure required to return drill fluid to surface. A Wiper Trip may be sufficient to prevent further Frac-Out.

Various Lost Circulation Material (LCM) drill fluid additives are available to seal fractures in the formation. These vary from locally available substances to specifically produced materials

such as mica flakes and proprietary chemical additives such as Diamond Seal™ or Micro-Fill™.

As a worst case scenario, cement may be forced into the bore to seal up the pathways. The cement plug can subsequently be drilled out or side-tracked.

It is often the case that a combination of containment and control will be required to enable economic completion of the bore.

Report

Should Frac Out occur, once the appropriate measures have been taken as above to contain and control, it MUST be reported to a PBU site supervisor or manager within 30 minutes from the time of occurrence or being detected. Photographs are to be taken prior to and after the containment and clean up operation.
Once the drill fluid has been contained and controlled it will be reported to the client as soon as is practicable by the quickest means in accordance with reporting procedure.