EPA Questions # 1, 3 and 5

Pre-Testing/Pre-Certification of Drilling Fluid/Mud Formulation

Introduction

Shell Exploration & Production Company – Alaska Venture (Shell) has developed the following response to address content within Questions #1, 3 and 5 of EPA on the content of Shell's previous comments on drilling fluid content (use of additives), formulation frequency and analysis of drilling fluids metal content upon Section II B of the draft NPDES general permit for oil and gas geotechnical surveys (GGP) in the Alaska Arctic Beaufort and Chukchi Seas (AKG-28-4300). Shell submits the following information to address EPA's request to Shell for follow-up information with regard to the requirement listed on Page 25 of the draft GGP:

> "*The permittee must analyze each drilling fluids system for the metal contaminants of concern (see Table A). This analysis is required once (1) per batch of drilling fluids mixed at the facility. If a new mixture of drilling fluids is created, or a new drilling fluids system is used during the geotechnical activities program, then an additional metals analysis is required for the new batch" and the requirements listed in Table 1, page 27.*"

Shell intends that our response supports a distinction between our use of terms to describe bulk volumes of drilling fluid addi tives and drilling mud. Shell uses the term "lot" to define the total amount of drilling fluid additives (including viscosifiers and weighting agents) procured from a vendor for an entire geotechnical survey program and the term "batch" to represent an individual mix of drilling fluid comprised of a portion of that lot mixed with seawater and used during execution of geotechnical boreholes within an individual survey program. There is only one lot per an entire geotechnical survey, while there will be multiple batches of drilling fluid mixed each season. Shell proposes that applicants under the draft GGP be allowed to meet the analytical requirement under II B(3) on page 25 of the GGP per lot of drilling additives versus pe r batch which are mixed multiple times in season. Shell's support for this rationale is to conduct a "pre-testing/pre-certification" of the maximum concentration of components that could be used in a drilling fluid mixture via an analysis consistent with I I B(3) of the draft GGP and have this done prior to execution of the geotechnical survey program . What is provided herein is believed to be a good representation of the process outlined at the current time . However, there may in the future need to be some alteration to the process owing to information/experiences obtained in the field and/or Shell's future developmental plans.

Drilling fluid consists of predominantly seawater, but on occasion may contain water -base gelling and weighting agent if the drilling fluid needs to maintain a positive head through the drill casing to mitigate the influence of "flowing" cohesionless soils. Shell assumes that seawater will be the d rilling fluid for all boreholes , but will be prepared with additives necessary as borehole site conditions may dictate. Boreholes of less than 50ft depth below the seabed likely will be advanced with only seawater as drilling fluid. There are even examples of geotechnical boreholes being advanced to upwards of 150 ft in depth without the use of drill mud additives on the North Slope; however, again, Shell will be prepared to utilize gelling/weighting agents as may be needed.

Prior to submitting notices of intent (NOIs) to discharge drilling fluids during geotechnical surveys, Shell would develop a drilling fluid p lan (DFP) for the boreholes proposed in the

geotechnical survey program. The applicant's DFP will define all of the additives (e.g., gelling agents ("Zeogel"); weighting agents (barite); guar gum; or polymer-based gel) that might be used for the surveys and it will describe the maximum concentrations of any additives used. Shell would then have the drilling fluid with the "maximum additive system" analyzed for Suspended Particulate Phase (SPP) toxicity and present the analytical results of such testing to EPA within the information supplied with the NOI for the geotechnical survey program. This approach affords EPA the ability to know in advance the SPP toxicity for the concentration of a drilling fluid that may be discharged during the program. Shell would assert that this should be sufficient for the entire geotechnical drilling program without additional testing of any drilling fluid components unless those components of the DFP should change, which as asserted below is not likely.

Shell expects that each borehole will be started with seawater (without additives) as the drilling fluid. Typically, the first sign of necessity to include drilling fluid additives in order to complete a borehole is encountered when unconsolidated sands and/or loose gravel is encountered in a borehole. Unconsolidated sands and gravel tend to "flow" into the borehole and cause the drill pipe to stick. Also there is the possibility for sand and/or gravel to enter the bottom-hole assembly and cause the sampling/coring tool to become stuck. This could cause this equipment to become damaged, or lost downhole. These situations need to be avoided.

The first step to alleviate the "flowing", unconsolidated sands/gravel is to mix a viscosifier (gelling agent) into the drilling fluid pit. The viscosifiers typically used are either naturally occurring Attapulgite Clay based products, Guargum, or a water soluble polymer based product. These viscosifiers tend to create a "wall pack" in the boring preventing the unconsolidated sand/gravel from flowing into the borehole. If this does not solve the problem then a densifier (weighting agent), normally barium sulfate, an inert product with specific gravity of 4.1, is added to the drilling fluid/mud mix in the pit. The densifier is mixed at quantities to cause the pressure head in the borehole to become greater than the pore pressures in the *in-situ* soils thereby stopping the flow of the unconsolidated sands/gravel into the borehole annulus. If Attapulgite Clay gelling or Barium Sulfate weighting products are not commercially available at the start of the geotechnical program, Shell may elect to use naturally occurring Guargum or a polymer-based gelling agent. It is important to note that no other chemical additives other than the four listed above would ever be considered for the drilling fluid/mud mixes utilized for geotechnical activities.

In addition, Shell would purchase and take on one lot of drilling fluid additives at the start of the season and store in bulk tanks (or bagged pallet products, depending on availability) onboard the vessel for use during the entire open-water season. Depending on the size of the mud pits on the operating vessel, multiple batches of mud may be mixed for a single borehole or if the tank capacity is larger, one batch of mud maybe used for sampling at multiple boreholes. Regardless of what quantities the mud is mixed in, one lot of barite will be used in a single season due to logistical and resupply constraints. Additionally, the quantities of additives used in the mud program will be consistent with the toxicity analysis run pre-mobilization and the formulations presented in the DFP. Thus, given that the materials that could actually be used as part of a fluids process (aside from seawater) would be pre-analyzed, it is not necessary to analyze them again prior to, during, or at the conclusion of mixing on the vessel.