Terms of Reference - Comprehensive Extended Reach Drilling (ERD) Study for Block 56

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1.1 OVERVIEW AND DISCUSSION OF DRILLING OPTIONS

The purpose of this document is provide background information on extended reach drilling (ERD) and describe Terms Of Reference (TOR) for a comprehensive ERD study for Block 56.

1.1.1 Basics of Oil and Gas Drilling

See **Attachment A** for an excellent discussion of basic drilling concepts and a simple figure showing all major components of the drilling operation.

1.1.2 Directional Drilling

Directional drilling is the ability to steer the drill-stem and bit to a desired bottomhole location and has been in use for the last half century. Prior to that time the only option was to drill wells vertically. Directional wells are initially drilled straight down to a predetermined depth and then gradually curved at one or more different points to penetrate one or more given target reservoirs. Directional drilling is usually accomplished with the use of a fluid-driven downhole motor, which turns the drill bit.

Directional drilling also allows multiple production and injection wells to be drilled from a single surface location such as a gravel pad or offshore production platform, thus minimizing cost and the surface impact of oil and gas drilling, production, and transportation facilities.

The limitations of directional drilling are primarily dependent upon maximum hole angle, rate of angle change, and torque or friction considerations. In directional drilling, it is now common for the horizontal displacement of the bottomhole location to be twice the vertical depth of the well. That is, a well with a vertical depth of 7,000 ft. could have a bottom hole horizontal displacement of 14,000 ft. from the drill site.

The proposed vertical depth of the Block 56 wells is approximately 7,000 feet (2,200 meters). See the well design proposed by PlusPetrol in environmental impact assessment for Block 56 at: http://www.minem.gob.pe/archivos/camisea/estudios/pluspetrol/L56_Cap_2_Anexo_I.pdf. These will be directionally drilled wells. However, the amount of horizontal displacement will be quite modest, approximately 2,500 feet (less than 1,000 meters).

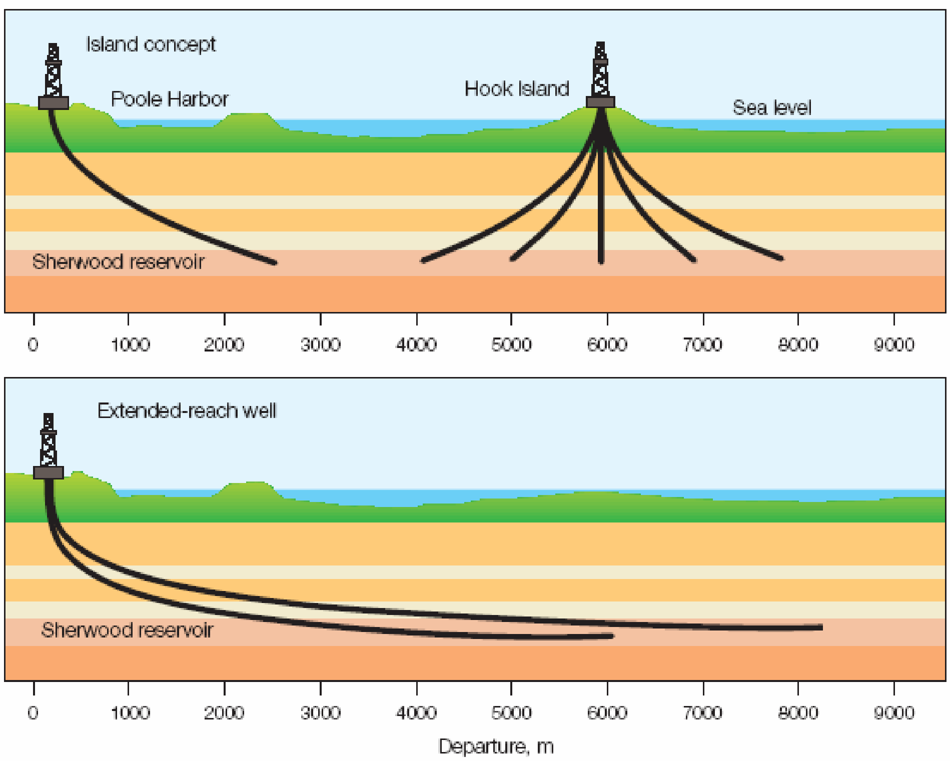
The type of geology or rock that must be drilled in order to reach a target may also limit directional drilling. Coal and shale deposits tend to collapse and cause the drill string to get stuck. This is more likely to happen in wells that take longer to drill, such that the downhole formations are exposed to the drilling mud and drill string longer. Stuck pipe can also occur in directional wells when the borehole becomes oval from the drill pipe constantly laying on the downside part of the wellbore. The pipe gets lodged in the groove cut on the bottom of the hole. The most common cause of hole collapse is the chemical difference between in-formation saltwater and the drilling mud.

1.1.3 Extended Reach Drilling

Extended-Reach Drilling (ERD) is essentially an advanced form of directional drilling. ERD employs both directional and horizontal drilling techniques and has the ability to achieve horizontal well departures and total vertical depth-to-horizontal distance ratios well beyond conventional directional drilling. More sophisticated steerable drilling equipment is utilized, along with continuous realtime monitoring of conditions in the wellbore. Greater care must also be taken to ensure the wellbore remains clean, via careful selection of drilling mud characteristics and flowrates and rotation of the drill string during drilling. Long ERD wells have been characterized as wells with greater than eight (8) kilometers of horizontal displacement.

Figure 1 compares the well profiles of directional wells and ERD wells in the same application. The upper graphic in Figure 1 depicts how conventional directional drilling could be applied to a coastal oilfield development, Wytch Farm, in southern England. The lower graphic depicts how ERD would be applied to achieve the same objective while eliminating the need for a second drilling pad. An ERD program was ultimately conducted at Wytch Farm in the mid- and late-1990s that established an 11-kilometer horizontal distance record and significantly reduced costs by eliminating the need to construct artificial islands from which conventional directional drilling would have been conducted.

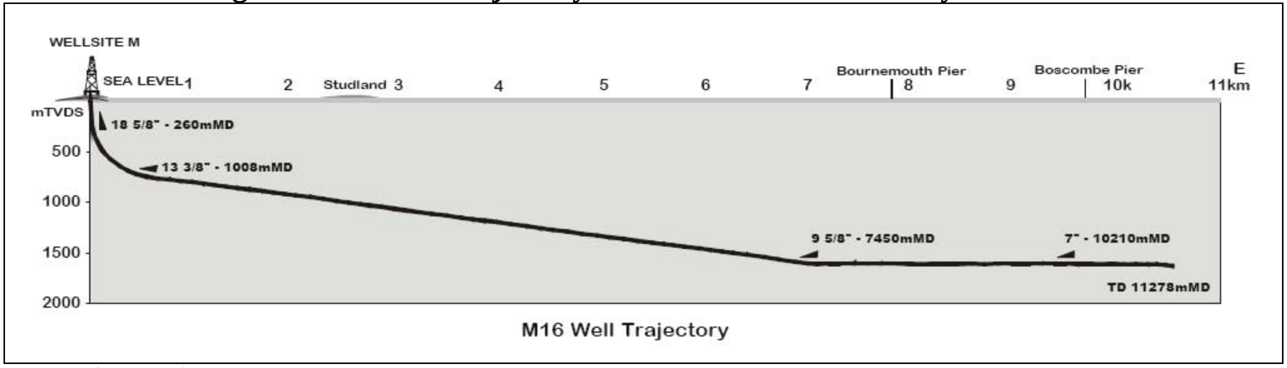
Figure 1. Conventional Directional Drilling and ERD Comparison, Wytch Farm



From: www.schlumberger.com "*Extending Reach Drilling: Breaking the 10-km Barrier*"

Figure 2 shows the trajectory of an actual 11-kilometer well at Wytch Farm.

Figure 2. Actual Trajectory of 11-km ERD Well at Wytch Farm



From: Society of Petroleum Engineers Paper No. 59204, *To the Limit and Beyond - The Secret of World-Class Extended-Reach Drilling Performance at Wytch Farm*, IADC/SPE Drilling Conference, New Orleans, February 2000.

1.2 PLANNING AND CONDUCTING AN ERD PROGRAM

Use of a consistent team to see the project through can be critical to its success given the inherently long planning and implementation time associated with an ERD drilling program. ERD programs generally push rig systems and available technologies to their limits. For this reason, a core design team that includes all of the relevant disciplines is critical. This team must consist of the lead drilling engineer, reservoir engineer, geologist, completions engineer and drilling operations representative. By designing a team in this manner, each aspect of the program is given its fare stake in the ERD design. Having drilling operations staff involved from the beginning helps to pave the way for acceptance of new ideas into the field by giving them ownership in the program.

Constraints to successful ERD include downhole drill string and casing movement, applying weight to the drill bit, possible buckling of casing or drill string, and running casing successfully to the bottom of the well.

Running normal-weight drill pipe to apply weight to the bit in ERD can lead to buckling of the drill pipe and rapid fatigue failure. Conventional drilling tools are prone to twist-off, because of unanticipated failure under the high loads of an ERD well. Torque can be significantly reduced with the use of non-rotating drill pipe protectors. Advanced equipment for an ERD well may include wider diameter drill pipe, additional mud pumps, enhanced solids control, higher capacity top drive, more generated power and oil-based drilling fluids. ERD requires longer hole sections, which requires longer drilling times. The result is increased exposure of destabilizing fluids to the wellbore. Water-based muds may not provide the inhibition or confining support of oil-based muds in an ERD application.

ERD has been instrumental in developing offshore reserves from shore at Wytch Farm, U.K. The original development plan called for the construction of a $260 million artificial island in the bay. Other successes with ERD include the North Sea, Gulf of Mexico, South China Sea, and North Slope Alaska. The current ERD horizontal displacement record of over 11 kilometers was established on the Sahkalin II project (Russia) in early 2005.

1.3 Drilling in Camisea – Difficulties and Countermeasures

The following paragraphs prepared by Schlumberger provide an excellent summary of the state of drilling knowledge of Camisea gas deposits. Schlumberger is PlusPetrol's drilling consultant for Camisea. Schlumberger is also the leading ERD consultant in the oil industry. The complete text is available at the Schlumberger website at: http://www.oilfield.slb.com/content/services/resources/casestudies/drilling/nds_camisea_pluspetrol_peru.asp?

Schlumberger's No Drilling Surprises (NDS) services helped PlusPetrol reduce drilling time and improve hole quality, saving them approximately $10 million on three wells in Peru's San Martin field, which is located in the Camisea blocks in the tectonically active foothills of the Andes. The major drilling problems avoided or resolved in achieving the savings included wellbore instability and poor bit and bottomhole assembly (BHA) performance. The collaboration between the NDS team, PlusPetrol, and other service providers also helped reduce other problems resulting from drilling fluid loss, hole cleaning, and reactive clays.

Prior to drilling the first of the three San Martin wells, the NDS team analyzed previous drilling problems in the area and created a plan for reducing drilling risk. A mechanical earth model created from drilling, wireline, geological, and seismic data was used to find the root causes of the drilling problems in offset ***(initial)*** *wells. Based on the results, the NDS team recommended a casing and mud program that would minimize hole instability problems. The mud program recommended adjustment of mud weights to better manage wellbore stability and the use of blocking additives to increase stability in microfractured formations.*

To reduce tripping (removing drill string from wellbore) non-productive time, the BHA and drill bits were configured to drill each hole section in a single run. A full-rotation PowerDrive rotary steerable system was used to improve hole cleaning and hydraulics and maintain the well trajectory in hard formations. Because of the improved hole quality achieved, there was a high success rate in running production liners to total well depth in the first attempt.*

PlusPetrol Senior Drilling Engineer J. Casanelli said, "The NDS process involves looking at data all the time, compares it with the offset and plan, and lets us know the deviations from the plan. It provides a process for the understanding of problems and the best practices to solve them."

1.4 Specific Training of Drilling Team Members Necessary for Efficient ERD Drilling

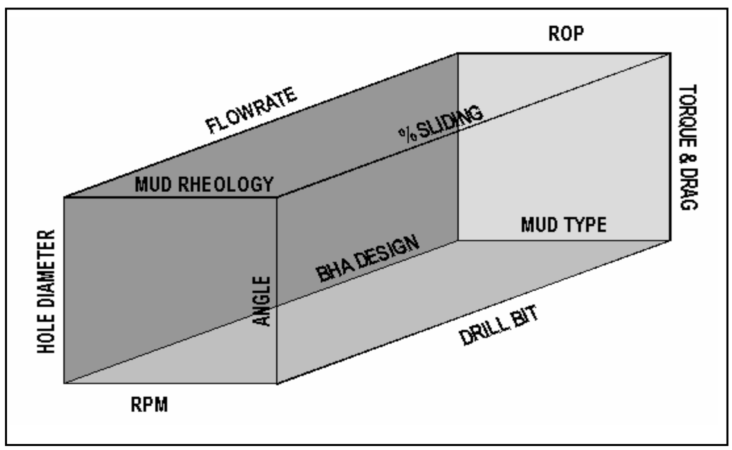
Operators can significantly reduce risks by making an attempt to move up the learning curve prior to detailed planning for an ERD well. This may include drilling warm-up wells and *gradually increasing reach and difficulty, or learning from what others in the area are doing (no point reinventing the wheel or making the same mistakes as others).*[1]

In the case of Block 56, it would make practical sense to drill the shortest ERD wells first (6 km to 7 km horizontal distance) to develop the expertise to efficiently drill the longer ERD wells. The Schlumberger "*No Drilling Surprises*" discussion provides an excellent roadmap of how to progressively increase drilling efficiency in a Camisea drilling campaign.

Training is perhaps one of the most important tools to reduce risk. It is essential that all personnel be fully trained in ERD operations. It should not be assumed that 'conventional' drilling experience is adequate. K&M has found that conventional drilling practices are generally not appropriate for ERD wells. Perhaps more importantly, the misconceptions and drilling practices that can be "gotten away with" on conventional wells cannot, necessarily, be tolerated on ERD wells.[2]

This comment is especially relevant to Camisea. PlusPetrol has extensive experience with directional drilling but no direct experience carrying out ERD drilling campaigns. Therefore comprehensive training of the drilling team in ERD procedures and practices would be absolutely essential to minimize avoidable problems during the drilling program.

The figure at left represents the "wholistic balance" approach that is necessary to maximize the efficiency of an ERD program.[3] Compromises must be made in a variety of areas to ensure maximum efficiency of the drilling progam.



1.5 ADAPTABILITY OF EXISTING CAMISEA DRILLING RIGS TO ERD

Existing "fly" (helicopter portable) rig(s) built by Parker Drilling (Houston) for PlusPetrol for use at Camisea should be sufficiently robust, with modifications, to be utilized in an ERD drilling campaign based on either a: 1) brute force approach or 2) rig-limited approach. The following excerpt addresses the differences between the "brute force" and "rig-limited" approaches to drilling ERD wells.[4]

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[1] K&M Technology Group, *Drilling Design and Implementation for Extended Reach and Complex Wells – 3rd Edition*, 2003, p. 34.
[2] Ibid, p. 35.
[3] Ibid, p. 90.
[4] Ibid, p. 36-37.

The conventional approach to building contingency into a well design (i.e. via use of larger hole sizes) may actually increase the overall risk in certain ERD wells compared to a well planned, "streamlined" or "slim hole" approach. In particular, often the highest risk and/or most challenging section of an ERD wells is the 12¼" section. This is primarily due to the difficulties associated with hole cleaning and directional control. If formation stability is time dependent, or if hole cleaning is too difficult to manage within the rig's capabilities, then a safer approach may actually be to drill a smaller hole size program. Although a smaller hole size may not allow a contingency hole size option, the reduced risk of encountering significant problems may offset this lack of flexibility. It should be noted, however, that any contingency planning must allow for the circulating mud pressures (know as equivalent circulating density or ECD) that are associated with small hole sizes.

As discussed later, and shown in one of the example wells at the end of this manual, drilling 13½" x 9⅞" hole to total depth may prove to be a safer and more efficient option as opposed to using a conventional 17½" x 12¼" x 8½"plan. The 9⅞" hole will afford much faster drilling than the 12¼" due to the improved hole cleaning conditions and directional control. As a result, the 9⅞" hole can be drilled further than the 12¼" hole before casing must be set due to hydraulics, torque or power limitations. Further, if ECD's at TD are a problem, then 9⅞" hole to TD will have lower ECD's than 8½" hole drilled beneath 9⅝" casing.

Another good example of using an aggressive approach to reduce risk is to use "over-sized" drillpipe. Instead of limiting the drillpipe size for full strength over-shot fishing capability, the risk of having a twist-off may be exponentially reduced by using larger drillpipe. For example, 4" drillpipe has about 50% greater torque capability compared to 3½", while having a substantially higher tension rating, and about 50% greater flowrates are possible. This results in better rate of progress due to improved bit hydraulics, better motor performance (steerable motors in slim hole often do not have sufficient flowrate for good operation) and improved hole cleaning. The net effect is not only reduced cost, but the risk of having to fish the drillpipe due to hole conditions is markedly reduced because of the improved drilling performance.

The required rig capabilities for drilling ERD wells are now becoming clearer as the industry drills more challenging wells with smaller rigs and improved technologies. The required rig capability depends very much on the drilling strategies and practices that will be used. Generally speaking, if 'off-the-shelf' conventional practices and technology are used, then significantly more capability is required from the rig, than if strategies and technologies are used that are specifically aimed at improved hole cleaning performance.

In the table below a comparison is made between two very different rigs that are drilling very similar ERD wells, to highlight what can be achieved. The biggest difference between the two programs is that the smaller rig forces the drilling team to work within its limitations to come up with design solutions to drill the well; whereby the larger rig has enough "grunt" to simply overcome many of the difficulties with brute force.

Comparison of "Rig-Limited" vs. "Brute Force ERD Drilling Programs[5]

ESSO AUSTRALIA LTD, FORTESCUE A-29 [RIG-LIMITED]	BP WYTCH FARM R5 [BRUTE FORCE]
Although the total depth (TD) and throw of this well is not particularly significant by today's standards, the well exceeded the rigs rated capabilities. The well was drilled and completed with 12¼" hole to TD. This well set several regional depth, reach and performance records and is believed to have set a world record for the longest ERD well with only 2 casing strings. K&M and Esso were awarded an Engineering Excellence Award for the achievement, given the limited rig capability.	At one time, this well held the world record for ERD. Although Wytch Farm is generally not a good project to benchmark against because of several unique factors that do not apply to most ERD wells, it is still a good comparison for the rig capability used. Although the final 8½" TD is significantly larger than the A-29 example, the 12¼" TD's are very similar. Given that the 12¼" section is often the most difficult part of an ERD well to drill, the two wells provide good benchmarking comparisons.
WELL DETAILS: • TD = 6210m MD (20,375 ft). • Throw = 5249m (17,221 ft) • 79° dropping to 45° (S-turn profile) • 17½" was drilled to 1500mMD (4,921 ft), and 12¼" drilled to TD. • Total days (drill and complete) were 53.4 days. Total days to 12¼" TD = 39 days.	• TD = 8700m measured depth (28,500 ft) • Throw = 8000m (26,250 ft) • +/- 82° tangent section, to horizontal • Includes 2000m (6,500 ft) horizontal section • 17½" to 1300m (4,250 ft), 12¼" to 6700m (22,000 ft), 8½" to TD. • Total time to drill to 12¼" TD 30-35 days. Additional 70-80 days to drill the 8½" horizontal section.
RIG CAPABILITY: • TDS-4 top drive (38,800 ft-lb.) • 2 x 1600 HP pumps • Electrical power = 4500 HP • 5½" drillpipe with HT-55 connections • Maximum surface pressure - 3,600 psi • *(flowrate at 12¼" TD was ±700 gpm)* • Drilling fluid = ester synthetic-based mud • Racking capacity = 5,000m of 5½" drill pipe • Derrick load = 1,000 kips	• TDS-4 top drive • 3 x 1600 HP pumps • 6000 HP electrical power, with mains power to supplement if required. • 65/8" drillpipe is used for 17½" hole • 5½" x 65/8" drillpipe is used for 12¼" hole, (5½" drillpipe has 60,000 ft-lb. connections) • 5½" x 5" S135 drillpipe is used for 8½" hole, (5" drillpipe has 4½" IF connections, 3½" ID) • Low Tox oil-based mud is used for 12¼" and 8½" sections. • Racking space for 9,000m (29,500 ft), with 50% each of 5" and 5½" drillpipe. • Nominal 2.3 million tons mast capacity.

[5] Ibid, p. 38.

Mud Pumping Capability for ERD Rigs:[6] *It is a general industry standard that at least 1,000 gpm is the minimum necessary flowrate required to clean a 12¼" section on an ERD well.* ***However, it is K&M's experience that it is possible to adequately clean 12¼" hole on 70°- 80° wells, with as little as 650-700 gpm, given good drilling practices and good planning.*** *The ability to clean the hole adequately with these low flowrates has now been tried and proven on many different ERD projects in locations around the world.*

In order to achieve this, not only do drilling and tripping practices have to be considered, but everything from bit selection to directional drilling equipment must be designed around maintaining good hole cleaning at all times.

Note that higher flowrates of 1,000 – 1,200 gpm are always preferred if possible. However, it is the author's view that in the case of flow rate, where more is better, a lot more may not necessarily be a lot better. There have been a number on instances on K&M's recent ERD projects where a point of diminishing returns seems to be realized with increasing flow rates. Although only limited evidence can be cited to support this, personal observations of wells that had higher flowrate capability did not show any significant improvement in performance, despite very high flow rates. Although, the authors do not subscribe to the theory of high annular velocities washing out (eroding) the wellbore, there is the risk of ECD induced 'fatiguing' of the wellbore at "ultra-high" flow rates (e.g. >1,200 gpm in 12¼" hole). Certainly, achievable penetration rates (whereby the hole is kept in good condition with respect to cuttings loading) seem to reach an optimum level dependent upon mud properties and good drilling practices.

Hydraulics limitations do not necessarily mean that performance is going to be greatly affected. Techniques have been developed whereby the hole is drilled "efficiently" rather than "fast" and performance curves for these operations rival (and often beat) those drilled with substantially more pumping power. This topic is expanded further in a number of sections in this text.

Obviously, more pumping capacity is preferred when designing or selecting a rig for ERD drilling (either via three rig pumps or two larger pumps). Three pumps may provide a redundancy benefit over a two-pump system. This becomes particularly relevant in deep 17½" and 12¼" hole sections. In most ERD wells drilled in the industry today, however, the addition of the third pump to the rig specifications needs to be justified on an efficiency basis. The global message is that these wells can be drilled with two pumps, but they can be drilled faster and more efficiently with three.

However, there are many occasions that a smaller rig capability is desirable. A classic scenario that K&M has encountered is that the 'required' rig capability, based on conventional practices, proves to be too large and heavy to be economically viable. Often it is not the rig cost that drives the project economics, but rather the production platform size, and cost that is required to support the drilling rig.

[6] Ibid, p. 39.

1.6 EQUIVALENT CIRCULATION DENSITY ISSUES AND COUNTERMEASURES

Equivalent Circulation Density (ERD) Discussion:[7] *Careful attention should be paid to fluid properties for any ERD application. If ECD's are critical, the fluid should be as thin as possible within hole cleaning restraints, and then further thinned prior to running and cementing casing. In particular, the fluid should have very good shear thinning capability. It may be necessary that hole cleaning properties take a back seat to ECD management with practices adopted to allow for this shortcoming.*

If ECD's are a problem in the production hole, one effective approach is to use a tapered drillstring to reduce annular pressure drops. ERD projects may require three or more separate drillstring sizes (4" x 5" x 5½") to manage ECD fluctuations, while maintaining the necessary torque and hydraulics capabilities. In these particular wells, normal pumping operations would have generated circulating annular pressures that exceed the fracture gradient. A purpose designed mud system, a tapered drillstring and a tapered casing plan would all help to reduce these pressures.

Tooljoint selection is also critical to ECD's. As already mentioned, in 8½" hole, the tooljoint clearance is quite small and will have a significant effect on annular pressures. Hole sizes larger than 8½" are not as sensitive to tooljoint size.

It is common to apply heavyweight drillpipe or larger outside diameter (OD) drillpipe in shallow ERD wells to overcome buckling problems. Alternately, the drillpipe can be stiffened by the addition of non- rotating drillpipe protectors (NRDPP's). If NRDPP's or larger OD drillpipe is used, then the ECD effect should be allowed for. NRDPP's add approximately 1 psi per unit, as a general rule. An option may be to use 'winged drillpipe' to provide stiffness while not increasing drag (as will occur with HWDP). The 'winged drillpipe' is significantly stiffer while not increasing ECD's as much as the other solutions.

[7] Ibid, p. 159-168.

2 TERMS OF REFERENCE - COMPREHENSIVE ERD STUDY FOR BLOCK 56

1. Evaluate three ERD drill pad location alternatives beginning with location that is most protective of environment and still technically feasible. Assume all Pagoreni A, B, and C wells will be drilled from a single location. The current world record ERD horizontal distance of over 11 km. Numerous ERD wells have been drilled in the 10- to 11-km horizontal distance range. An ERD drilling pad in the vicinity of proposed Campamento 9 is the "best case" ERD alternative. Maximum horizontal distance from Campamento km 9 to Pagoreni C is ~10.5 km**.** All wells drilled from this location would range from 7 to 10.5 km in horizontal distance. See **Figure ERD-1**.

2. The intermediate ERD alternative would be a location 2 km due north of proposed Campamento km 9 (11 km north of Malvinas). Horizontal distances would range from 5 to 9 km. See **Figure ERD-2**.

3. The minimum distance location 3 km due north of proposed Campamento km 9 (12 km north of Malvinas). Horizontal distances would range from 4.5 to 8 km. See **Figure ERD-3**. PlusPetrol is proposing very modest horizontal distances in the directional drilling program proposed for Block 56, less than 1 km for wells with a total vertical depth of 2,200 meters. The one ERD approach analyzed by PlusPetrol in the May 2005 ERD analysis for the Cashiriari deposit indicated the only technical hurdle encountered up to 8.4 km was the potential for sinusoidal buckling of the drill string.[8] See May 2005 PlusPetrol ERD feasibility analysis for Block 56, p. 9. Sinusoidal buckling countermeasures, such as bladed drillpipe, non-rotating drillpipe protectors, increasing drillpipe diameter, or modified well trajectory, can readily be incorporated to eliminate the potential for buckling. See **Attachment B** for details on sinusoidal buckling countermeasures. Given the PlusPetrol ERD analysis deals with a single brute force, unoptimized ERD well design, it can reasonably be assumed that 8.4 km is a minimum feasible ERD distance in the Camisea region.

4. Evaluate each ERD location assuming rig-limited ERD will be used and assess technical feasibility in this light.

5. Evaluate each ERD location assuming "brute force" ERD will be used and assess technical feasibility of accordingly.

6. Make maximize use of existing data developed in the San Martin drilling campaign in this ERD analysis. See Schlumberger discussion of San Martin at: www.slb.com/oilfield

[8] PlusPetrol, *Block 56 Extended Reach Drilling Wells Feasibility Analysis*, PowerPoint presentation, May 2005, p. 9.

7. Prepare an ERD Preliminary Well Design Assessment using the following format:

ERD Preliminary Well Design Assessment Format

INTRODUCTION AND SUMMARY	• Purpose and scope of the report • Include a summary upfront, which gives an overview of the final preliminary well design and highlights the key areas of the well (include a well schematic)
FIELD AND GEOLOGY OVERVIEW	• Overview of the ERD well position in the field • Formation tops and lithology description, highlight target requirements • Discussion of pore pressure, fracture gradient and temperature profile
WELL DESIGN OVERVIEW	• Surface location (slot allocation, etc.) • Casing design (casing sizes and depths, alternatives) • Wellpath design (alternative build rates and profiles) • Drilling fluids (oil-based mud, water-based, approximate weights) • Friction factors for torque & drag (T&D) planning (what's the basis?)
17½" HOLE	• Key issues and priorities • Directional strategy (wellpath, general BHA/bit strategy, etc.) • Drill Fluids (mud type and weight range, etc.) • Hydraulics (pressure and equivalent circulating density (ECD), pump capability, drillpipe sizes, etc.) • T&D (tripping weights, buckling, torque, negative weight, etc.) • Power requirements (backreaming at total depth) • Attach T&D and hydraulics plots
13⅜" CASING	• Casing running (drag risk plots, flotation, rotation, rollers, other contingencies) • Cementing issues (general cementing and centralization plan)
12¼" HOLE	• As for 17½" hole
9⅝" CASING	• As for 13⅜" casing
8½" HOLE	• As for 17½" hole
LINER	• As for 13⅜" casing
CLEANOUT AND COMPLETION	• Cleanout and completion running (drag risk plots, rollers, buckling, etc.)
EQUIPMENT SPECS	• Required rig equipment (top drive, pumps, drawworks, power, solids control, etc.) • Other equipment required (drillpipe size, drilling tools etc.)
INDUSTRY BENCHMARKING	• Comparison with other relevant ERD wells to establish feasibility • Compare well design and rig capabilities
TIME AND COST ESTIMATES	• ± 40% time and cost estimate based on Preliminary Well Design

8. Prepare an ERD Detailed Well Design Assessment for the most technically promising well design determined in the Preliminary Well Design Assessment for each of the three potential ERD drilling locations. Use the following format:

ERD Detailed Well Design Assessment Format

FIELD AND GEOLOGY OVERVIEW	• Key issues in each hole section • Reservoir schematics • Graphs of pore pressure, fracture gradient and temperature profile
WELL DESIGN OVERVIEW	• Wellpath Summary (kick-off point, build rates, tangent angles, collision avoidance etc.) • Casing Summary (casing sizes, depths, weight and grade, summary of main drivers) • Cementing Summary (cement tops, slurry design, special requirements, etc.) • Drilling Fluids Summary (mud type and weight, priorities, properties, etc.) • Bit and BHA Summary (listing of BHA's and components, contingencies, etc.)
17½" HOLE	• Key Issues (list the key issues and main priorities in this section) • Overview of Solutions (discuss solutions to the key issues) • Detailed Procedure Outline (step-by-step procedure of how the section is to be completed, include hole cleaning and tripping guidelines, etc.) • Special notes and offset calibration (other issues, provide calibration data for the section to show where it has been done before) • Attach T&D and hydraulics plots
13⅜" CASING	• Key Issues (list the key issues in this section) • Overview of Solutions (discuss solutions to the key issues) • Detailed Procedure Outline (step by step procedure: prior to casing run, casing run and cementing) • Special Notes and Offset Calibration (other issues, provide calibration data for the section to show where it has been done before) • Attach T&D and hydraulics plots
12¼" HOLE	• As for 17½" hole
9⅝" CASING	• As for 13⅜" casing
8½" HOLE	• As for 17½" hole
LINER	• As for 13⅜" casing
CLEANOUT AND COMPLETION	• As for 13⅜" casing, but procedure outline will most likely not be very detailed as the cleanout and completion is usually not finalized until later in the well.
EQUIPMENT SPECS	• Final equipment specs (top drive, pumps, drawworks, power, solids control, etc.) • Other equipment specs (drillpipe size, casing, directional drilling tools etc.)
TIME AND COST ESTIMATES	• ± 20% time and cost estimate based on Detailed Well Design