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# ENGINEERING ERD

Independent delivery assurance and support for extended reach and challenging high angle wells – from upfront engineering, training, through to execution in the field, Merlin ensures project value is delivered and objectives are met.

## SERVICE LIST

- OFFSET WELL REVIEW
- FEASIBILITY STUDY
- PROBLEM REVIEW
- DETAILED WELL DESIGN
- PERFORMANCE OPTIMISATION





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# ENGINEERING ERD

## OFFSET WELL REVIEW

The offset well review is where it all starts. It's the foundation for reliable well delivery later on down the track. The objective, supportable assumptions which are validated through this exercise create a firm base for which to layer on the complexities involved in extended reach, high angle and complex wells. Reviewing 3 to 5 wells provides the most reliable data to verify friction factors and subsurface modelling assumptions, ensuring that subsequent conceptual well designs and feasibility studies are grounded in fact, with the lowest possible uncertainty.



## FEASIBILITY STUDY

Accurately determine what it will take to reach a prospect from existing infrastructure. Define a dependable drilling radius for field development planning and/or to identify minimum rig specifications for your challenging wells. These are a few of the factors that a detailed feasibility study allows the drilling manager to assess. Merlin's work is based on our knowledge of what's possible, gained from working on the industry's most challenging wells in over 40 countries.

# ENGINEERING ERD



## PROBLEM REVIEW

Fresh eyes and a lack of preconceived ideas is what Merlin brings to a problem review. Our focus on challenging extended reach wells enables us to provide a unique view on wells which have experienced difficulties during the construction process. By assessing drilling operations against an ERD methodology, we are able to identify areas where a revision to engineering or operational practices will yield performance improvements and a reduction in unplanned events.

# ENGINEERING ERD

## DETAILED WELL DESIGN

Systematically building on the offset review and feasibility study outputs, the detailed well design is the last opportunity to make sure that critical risks are engineered out of the well architecture, rather than controlled through process. Merlin can undertake the detailed design work in its entirety or support in specific areas – whatever is necessary to create the greatest opportunity to assure drilling success. Specifically, we can support with trajectory design, targets, drill string and BHA design, casing scheme options, drilling fluid specification and properties, wellbore stability and casing wear assessments as well as any of the other routine and not so routine considerations which feed into a complex well design.



# ENGINEERING ERD

## PERFORMANCE OPTIMISATION

Successful, reliable well delivery is the first challenge to be overcome on many projects. Once that's in the bag, how do we ensure we keep moving up the performance learning curve? Keeping the bit on bottom and drilling efficiently whilst minimizing energy lost through vibration, understanding system limits to optimize tripping speeds for drill pipe and casing, proactively managing planning and programming activities to gather and integrate lessons learned – all of these activities will allow us to drill further, faster, more efficiently, more often. Merlin's integrated performance optimisation processes can facilitate this process quickly and efficiently.



# ENGINEERING MPD

Tight operating margins or abnormal reservoirs create complex wells. Merlin's MPD service is designed to allow operators to understand the options available and how these techniques will create benefit through the design and execution stages of their well delivery process.

## SERVICE LIST

- FEASIBILITY STUDY
- WELL DESIGN
- CONTRACTING
- EQUIPMENT SPEC
- HAZOP, HAZID AND RISK ASSESSMENTS
- PROCEDURES
- FEED





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# ENGINEERING MPD

## FEASIBILITY STUDY

Are you drilling an HPHT well, operating in a narrow window within the reservoir, or have wellbore stability challenges which require more finesse than drilling with a simple mud weight for the duration of a section? These sorts of challenges may highlight the need for a managed pressure drilling solution in order to mitigate risk and enable you to reliably achieve your well's objectives. Merlin applies a back-to-basics engineering approach to help you decide if MPD is required to make drilling a particular well feasible.



# ENGINEERING MPD

## WELL DESIGN

MPD comes with its own unique set of challenges and considerations. It also comes with an opportunity to start doing things in a different way. Perhaps you can push a shoe deeper, shorten a high risk section, or remove a casing string altogether if the subsurface environment is right. Merlin can help you create wells which harness the capability of managed pressure drilling, taking advantage of this enabling technology to reduce risks and costs.



# ENGINEERING MPD

## CONTRACTING

If you know you need MPD but are not sure exactly what the operating model is going to look like, give Merlin a call. There are many ways to manage a spread, whether it's hired directly by the operating company or via a third party contractor (e.g. the rig), Merlin can advise on the most appropriate way to contract the equipment to ensure that your risks are covered, whichever side of the bench you sit on.



## EQUIPMENT SPEC

You have a feasibility analysis in place and a well design which relies on managed pressure drilling – what next? Do you know what equipment you need? Do you feel like the advice you are getting is completely unbiased? Does it consider the needs of the well, rather than what's available locally or what's easily to hand? When the rig says it's MPD ready, what does that mean? Merlin's expertise and experience can help you define a solution which is fit-for-purpose with the minimum of cost and complexity.

# ENGINEERING MPD

## HAZOP, HAZID AND RISK ASSESSMENTS

If you are looking for independent participation in a HAZOP, HAZID or risk assessment workshop, Merlin can help. Merlin's people have designed, constructed and operated wells and MPD spreads all over the world, from desert land rigs to deepwater semi-subs. Merlin deeply understands the risks and mitigating factors associated with the use of this equipment along with the questions which often don't get asked (but should) in these forums. Allow Merlin to support your occupational safety process and improve your delivery reliability.





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# ENGINEERING MPD

## PROCEDURES

Mechanical design and operational procedures go hand-in-hand when it comes to assuring reliable well delivery with an MPD spread on location. Merlin can support the development of tried and tested procedures based on international best practice for all types of managed pressure drilling operations, ensuring that your well starts as far up the learning curve as possible.



## FEED

Merlin can assist at all stages in the process of defining whether your well or project is a suitable candidate for MPD. During FEED, Merlin supports rig surveys, P&ID development, interface planning, equipment preparation, testing & certification requirements, regardless of your operating environment. Merlin can assist with all of the steps required to transform your location into something fit for the purpose of executing your MPD well successfully.

# ENGINEERING GEOTHERMAL

Drilling for heat comes with its own set of challenges, demanding rigour in planning and execution to assure success in a sensitive commercial environment. Best practice, derived from lessons learned on the world's most challenging wells ensures drilling projects are developed sustainably.

## SERVICE LIST

- OFFSET WELL REVIEW
- FEASIBILITY STUDY
- PROBLEM REVIEW
- WELL DESIGN





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# ENGINEERING GEOTHERMAL

## OFFSET WELL REVIEW

Geothermal drilling means different things to different people. Regardless of whether you are drilling granite for steam or coal seams for warm water, understanding the challenges which have gone before is the foundation for planning a well which will meet the subsurface objectives whilst accounting for risk. Merlin are experts at unpacking the real lessons from the noise to deliver this foundational information in a way which promotes reliability in well design and execution in the later stages.

## FEASIBILITY STUDY

As engineers, we often have limits imposed on us. It could be down to the drilling location, the equipment we have available or the economics (and hence allowable budget) of the project we are working on. We need to know how the mechanical design of our geothermal well will impact on those constraints to make a value judgement on what to do next. A detailed feasibility study sets out what the well needs to look like in order to remain within the boundaries of your project. Merlin can help you understand where the critical elements are to ensure that your solution remains within limits at all times.

# ENGINEERING GEOTHERMAL

## PROBLEM REVIEW

"When the going gets tough, the tough get going." Operational problems are tough going. Large bore, high angle wellbores, small, shallow wellbores with precise directional control requirements, limited resources to achieve the well objectives – all situations which can stress teams and create opportunities for failures to creep in. Merlin has been involved in problem reviews since the inception of our business. We know it takes sensitivity and a focus on facts to get to the bottom of what went wrong and what's gone on in a way which brings the best out of the team. Our focus is on supporting the team to integrate the lessons learned from the problem event into the next activity.



# ENGINEERING GEOTHERMAL

## WELL DESIGN

We are drilling engineers. Regardless of the downhole conditions, we can help you create well designs which meet the subsurface objectives, regardless of the fluid being produced. Optimised well designs come from a detailed understanding the subsurface environment and the constraints likely to be imposed by the available solutions. Our drilling engineers can help you define hole sizes, wellhead types, casing points, drilling fluids, drilling tools and so on – all of the individual elements which come together when the rig is on location to create the final end result. Merlin's engineering focus is on designing out risk where we can and mitigating through procedure were necessary.



# ENGINEERING COMPLEX

Merlin's Drilling Engineers are problem solvers. From deep-water exploration into tectonically unstable zones, to wells in complex geomechanical environments, Merlin has seen and helped solve problems believed to be intractable, and engineered wells previously thought undrillable.

## SERVICE LIST

- OFFSET WELL REVIEW
- FEASIBILITY STUDY
- PROBLEM REVIEW
- WELL DESIGN





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# ENGINEERING COMPLEX

## OFFSET WELL REVIEW

What is a "complex" well? It could mean a deepwater well, if you are used to shelf drilling, or multilaterals if you only drill single-leg horizontals. Regardless of what you are going to be doing, reviewing what's been done before by your company and others is a fundamental part of the well design process. Facts are power is a phrase we repeat often in our training and it applies particularly to this exercise. Merlin's well delivery process has been created to integrate this fact finding into a process designed to ultimately deliver reliable drilling operations.

## FEASIBILITY STUDY

Complex challenges require clear definition of objectives and constraints to be successful. In the early stages of a project, undertaking a detailed feasibility study is the best way to ensure that the objectives can be achieved given the constraints applied, whether they are subsurface or project based. Merlin has a broad range of tools and experiences through our pioneering work in extended reach wells, which can be applied successfully to other complex well types.

# ENGINEERING COMPLEX

## PROBLEM REVIEW

Despite our best intentions, problems during drilling and completion activities can occur on complex wells. Merlin has been involved in problem reviews since our founding in 2007. Whether it's a twist off, sidetrack, drilling dysfunction affecting ROP or another problem we have the capability to get involved and make a factual, objective assessment of the situation and what needs to be done next time to avoid further reoccurrences.

## WELL DESIGN REVIEW

Planning something out of the ordinary with your team? An extra set of competent eyes reviewing and challenging your well designs or operational plans is cheap insurance compared to the costs which can rack up if something slips through the net and causes a problem on location. The best organisations embrace this process, as an opportunity to validate their plans and learn from what others with similar challenges across the globe are doing to keep ahead of the game. Merlin's competence, gained from the worlds most complex wells, allows us to facilitate this knowledge transfer.

# TRAINING ERD & COMPLEX

Well complexity means different things to different people. Whether it's the first high angle well in the field, or you are planning a 10km tri-lateral, we can support reliable project execution through targeted training on the fundamentals of complex well construction.



## TRAINING OPTIONS

- PUBLIC OPEN SEAT
- CLIENT SPECIFIC AND BESPOKE TRANING COURSE
- SIMULATOR TRAINING





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# TRAINING ERD & COMPLEX

## PUBLIC OPEN SEAT

Better educated people make better decisions. Merlin's training is designed to teach the fundamental aspects of high angle drilling which lead to successful outcomes, from a basic understanding about how high angle wells differ from vertical wells, through to detailed explanations around where torque, drag and hydraulics loads come from and how they need to be modelled and managed to assure success operationally. We also talk about cleaning up, tripping, stuck pipe risks, wellbore stability, and many other topics on our engineering and operations open seat courses, available to anyone with an interest or responsibility for drilling operations. This course is normally run over three days when in a face-to-face setting or over five half days if being run remotely.





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# TRAINING ERD & COMPLEX

## CLIENT SPECIFIC AND BESPOKE TRAINING COURSE

For large development projects or high profile wells, clients often ask us to tailor a course for their specific requirements. Merlin base the curriculum on the fundamental topics surrounding hole cleaning and condition monitoring. We can add and subtract additional modules based on the geological environment or the risks likely to be be encountered. We can also take specific aspects of the well design or previous operational lessons learned which are used to craft individual or group exercises to reinforce critical topics. The courses can be taught face-to-face when conditions allow, or virtually when necessary.





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# TRAINING ERD & COMPLEX

## SIMULATOR TRAINING

In addition to the classroom and remote training on offer, Merlin has successfully incorporated simulator time in order to reinforce key learning outcomes. These courses take place face-to-face, with around 50% of the time spent in the classroom and the remaining 50% of the time in the simulator, running exercises which reinforce the theoretical material taught in the classroom. In addition, we can structure simulator exercises based on situations the delegates are likely to experience on the next well they are going to drill. It all adds up to a compelling training experience which adds value to all team members – from the Drilling Manager to the Derrickman.



# TRAINING MPD

Considering MPD as an enabling technology on your well? Merlin's training will lead you through the subject, from fundamentals to advanced techniques, giving you the tools to successfully execute your MPD project.

## TRAINING OPTIONS

- PUBLIC OPEN SEAT
- CLIENT SCHOOLS





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# TRAINING MPD

## PUBLIC OPEN SEAT

Similar to Merlin's renowned extended reach, high angle and complex well training course, Merlin's MPD open seat course is designed to teach the fundamental success factors across a range of MPD techniques, from the technical drivers through to equipment standards and certification. Courses are delivered over a period of three days in the classroom, or split over five half-days if taught online. Topics include deep dives into the drivers for use of MPD, types of MPD systems, the design criteria associated with each type, how to decide which system to use, management of anchor points, well control considerations, equipment specifications and much more.



# TRAINING MPD

## CLIENT SCHOOLS

In addition to the public open seat courses, Merlin also creates bespoke training based on individual client needs for a particular campaign or well. Our courses feature an interesting mix of theoretical class work, mixed with group exercises on real world problems to illustrate the relevance of the material. These courses incorporate the clients own information to provide context for the delegates.



# TRAINING GEOTHERMAL

High angle, large diameter wells are often required to deliver the kind of flow rates needed to provide heat for domestic and industrial applications. Merlin's training is designed to upskill teams on the critical success factors, ensuring that wells are delivered on time and on budget.

## TRAINING OPTIONS

- PUBLIC OPEN SEAT
- CLIENT SCHOOLS
- SIMULATOR TRAINING





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# TRAINING GEOTHERMAL

## PUBLIC OPEN SEAT

Drilling operations come in all shapes and sizes but the fundamental processes are the same, regardless of whether you are drilling for heat or hydrocarbons. Merlin's public open seat training courses (classroom or online) have taught hundreds of delegates the fundamental success factors related to the well construction process, with a focus on deviated and high angle wells. It is also true that the factors that make these complex wells successful translate equally well to vertical, shallow or low angle wells when we talk about proactively managing hole conditions, how to write SMART drilling instructions, specifying drilling fluid properties, or size a drilling team. We discuss all of these topics and more in our internationally recognised training courses.



# TRAINING GEOTHERMAL

## CLIENT SCHOOLS

For some clients with larger projects or high profile wells we tailor specific courses to suit the needs of these groups. Perhaps your doublet has a pair of shallow horizontal sections or large diameter surface holes to deal with large production flow rates. These sections have their own particular sets of challenges. As industry leading training providers, Merlin can adjust the agenda to more closely reflect the situation that the operational team will find themselves in, or create exercises based on previous examples from the field. These courses can be taught face-to-face if possible or virtually, should it be difficult to bring the team together in one place before operations begin.



# TRAINING GEOTHERMAL

## SIMULATOR TRAINING

Human beings learn best by doing. Using a drilling simulator (e.g. Drilling Systems DrillSIM:5000) to reinforce the theory taught in class is a great way to ensure that the operational team is up to speed on the challenges they are likely to face on the well. These sessions are run in the classroom with around 50% of the work based on theory, the remainder of the time spent in the simulator, working through related challenges using real scenarios from the well.





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# OPERATIONS ERD

Independent delivery assurance and support for extended reach and challenging high angle wells – from upfront engineering, training, through to execution in the field, Merlin ensures project value is delivered and objectives are met.

## SERVICE LIST

- RIGSITE HOLE CONDITION MONITORING
- REMOTE OPERATIONAL SUPPORT
- CREW COACHING
- PRACTICES AND PROCEDURES
- DRILLING OPTIMISATION





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# OPERATIONS ERD



## RIGSITE HOLE CONDITION MONITORING

Merlin's hole condition monitoring services revolve around supporting drilling operations at the rigsite. Not only is Merlin able to help its clients proactively manage their drilling performance during high angle hole sections, we also provide early warning of problems based on deviations from expected trends. Merlin's independent specialists develop and interpret torque, drag, ECD, swab and surge models with the aim to reduce drilling risk and improve reliability of execution across drilling, tripping and pipe running operations.

# OPERATIONS ERD

## REMOTE OPERATIONAL SUPPORT

If getting to the rig is not feasible, Merlin's hole condition monitoring service can be undertaken remotely. With access to your realtime data stream, Merlin's specialists proactively monitor and manage drilling performance and provide early warning of problems developing down hole. Merlin's know-how and experience allows the business to differentiate itself from the other remote services because we think like you do: Merlin's independence means we are focussed on making sure that we are doing what's best for the well, regardless of the colour of the equipment we are working with.



# OPERATIONS ERD

## CREW COACHING

Stacked rigs and green crews add risk to complex well projects. Merlin's ERD specialists are highly experienced, often with time spent as a Drilling Engineer, Drilling Supervisor or other skillset such as a Directional Driller on their resume. They understand the fundamentals of high angle drilling as well as the soft-skills required to explain what's happening downhole and why we are planning to do something in a specific way. These skills can be used to coach and mentor rig teams who are beginning their performance journey, to ensure that the right decisions are made at the right time.

## PRACTICES AND PROCEDURES

On location, Merlin's ERD specialists make sure that the drilling procedures being used are objective and consistent with international best practice. Previous incidents have shown that objective instructions are the best way to guarantee a consistent output – minimizing risk through the avoidance of misinterpretation of commonly occurring activities (e.g. starting and stopping pumps for example). Merlin's experience guarantees that that you will be using tried and tested techniques, designed for success on the world's longest wells.

# OPERATIONS ERD



## DRILLING OPTIMISATION

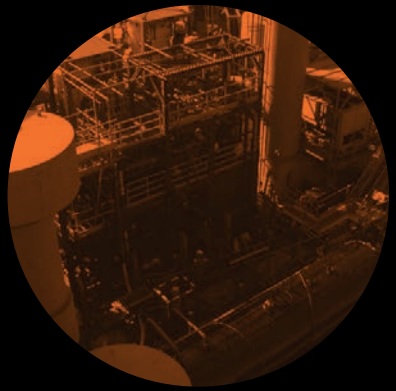
It's not just about avoiding the train-wrecks. Many operators have proceduralised performance management systems which are used to great effect to identify and design out whatever is limiting them from drilling faster, cleaning up more efficiently, or running and cementing pipe more effectively. Merlin has developed its own drilling optimization methodology which is now being deployed successfully on locations world-wide, allowing clients to drill further, faster, more efficiently. They understand the fundamentals of high angle drilling as well as the soft-skills required to explain what's happening downhole and why we are planning to do something in a specific way. These skills can be used to coach and mentor rig teams who are beginning their performance journey, to ensure that the right decisions are made at the right time.

# OPERATIONS MPD

Tight operating margins or abnormal reservoirs create complex wells. Merlin's MPD service is designed to allow Operators to understand the options available and how these techniques will create benefit through the design and execution stages of their well delivery process.

## SERVICE LIST

- RIG INTEGRATION
- OPERATIONS SUPPORT





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# OPERATIONS MPD

## RIG INTEGRATION

Building an MPD spread on the rig and integrating it into into the drilling package takes time, effort and experience. There is a huge range of variables to be considered – the system set up, available space, available power, piping requirements, certification and warranty considerations, manning levels and so on. All conspire to cause problems which need attention to detail in the planning and execution phases. Merlin's experience allows us to help you avoid the opportunities for cost over-run and delay which comes with the territory.



## OPERATIONS SUPPORT

MPD, PMCD, riser mud-level control, it doesn't matter what set up you are using, we can support you on location when drilling ahead in your sensitive hole sections.

# OPERATIONS GEOTHERMAL

Drilling for heat comes with its own set of challenges, demanding rigour in planning and execution to assure success in a sensitive commercial environment. Best practice, derived from lessons learned on the world's most challenging wells ensures drilling projects are developed sustainably.

## SERVICE LIST

- PRACTICES & PROCEDURES
- PROACTIVE PERFORMANCE
- ONSITE MENTORING AND KNOWLEDGE TRANSFER





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# OPERATIONS GEOTHERMAL

## PRACTICES & PROCEDURES

The physics of how cuttings move from the bottom to the top of the well does not change in relation to what is being drilled. Operational requirements will vary according to hole size, inclination, the drill string and subsurface pressure limits. From experience of drilling the world's longest wells, Merlin's onsite advisors are experts in ensuring that the practices and procedures employed on your Geothermal well are consistent with what is done internationally in other environments, getting you up the leaning curve quickly and helping to avoid mistakes.



# OPERATIONS GEOTHERMAL

## PROACTIVE PERFORMANCE

Geothermal wells require excellence in execution. These developments are often charaterised by marginally positive project value with payback periods stretching into decades. Problems executing wells, leading to cost over-runs are very likely to push a marginal project over the edge. Merlin's advisors take a proactive approach to well delivery and performance management onsite. They support the client's drilling supervisor to ensure that focus never deviates from what the well needs at any given point.

## ONSITE MENTORING AND KNOWLEDGE TRANSFER

Having an additional pair of experienced eyes at the well is cheap insurance. Economic conditions have conspired to create an inexperienced labour force across all aspects of the drilling business. Merlin's onsite personnel typically have 20 years plus of experience in well execution, often as Drilling Supervisors, or highly experienced senior service hands. This knowledge allows us to see problems developing before they become critical, allowing us to guide and mentor personnel at the rigsite.

# OPERATIONS COMPLEX

Merlin's Drilling Engineers are problem solvers. From deep-water exploration into tectonically unstable zones, to drilling high angle wells with limited capacity helicopter-portable rigs, Merlin has seen and helped solve problems believed to be intractable, and engineered wells previously thought undrillable.

## SERVICE LIST

- PRACTICES & PROCEDURES
- HOLE CONDITION MONITORING
- CREW COACHING
- DRILLING OPTIMISATION





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# OPERATIONS COMPLEX

## PRACTICES & PROCEDURES

On location, Merlin's advisors make sure that the practices and procedures being used on your complex well account for known subsurface and equipment risk factors, and are objective, avoiding the opportunity for misinterpretation. Merlin's international experience shows that objective instructions are the best way to guarantee a consistent output on activities which are taking the team out of their comfort zone.



## HOLE CONDITION MONITORING

At the rigsite, Merlin's independent specialists develop and interpret torque, drag, ECD, swab and surge models with the aim to reduce drilling risk and improve reliability of execution across drilling, tripping, and pipe running on your complex wells.

# OPERATIONS COMPLEX

## CREW COACHING

Stacked rigs and green crews add risk to complex well projects. Merlin's independent specialists are highly experienced, often with time spent as a Drilling Engineer, Drilling Supervisor, or other skillset such as a Directional Driller on their resume. They understand the fundamental aspects of complex wells and possess the communication skills necessary to explain why we are recommending things be done in a specific way. These skills are used to coach and mentor rig teams who are beginning their journey, to ensure that the right decisions are made at the right time.

## DRILLING OPTIMISATION

Many operators have proceduralized performance management systems which are used to great effect to identify and design out whatever is limiting them from drilling faster, cleaning up more efficiently or running and cementing pipe more effectively. Merlin has developed its own drilling optimization methodology which is now being deployed successfully on locations world-wide, allowing clients to drill their complex wells further, faster, more efficiently.




# Merlin – Complex Wells. Delivered.

We are world-class drilling engineering advisors, collaborators, and educators – specialising in delivery assurance for extended reach and complex wells. Established in 2007, we have helped clients successfully deliver over 400 projects in 47 countries.

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