22nd DCA Annual Congress | Dordrecht

HDD-First

04th - 06th October 2017
Dordrecht, Nederlands

DCA Annual Congress 2017

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BAROID Industrial Drilling Products Halliburton
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gasunie

Drilling Contractors Association (www.dca-europe.org)

Editoral

Dear Ladies and Gentlemen, Dear Members of the DCA,

For the first time in my new position I am allowed to invite you to DCA's annual congress. I am looking forward to welcoming you to the Dutch city Dordrecht in province South-Holland from October 04 - 06, 2017. Dordrecht was granted city rights in the year 1220 and thus is the eldest city of former Holland and second eldest of the Netherlands. Situated south-east of Rotterdam midst a branching stream landscape, Dordrecht offers a picturesque atmosphere with historic inland harbours and numerous monuments.

We are hoping that we can persuade you to join us at our congress with the prospect of a nice ambience of this event - albeit the enclosed lecture programme hopefully no less arouses interest. I thank all those that were involved in planning the programme, or those who will contribute a lot as lecturers, as well as the encouragingly large number of sponsors.

The guiding theme of this year's annual congress is "HDD First" - short and simple. Those recognising a parallel to a critically discussed slogan of the American election campaign might not be wrong. But contrary to politics, the DCA as representative of companies operating economically is somewhat more legitimated or even obligated to particularly foreground the interests of its members.

HDD First - in the field of trenchless pipeline technology HDD is the most widely used and the most efficient construction method. We want to work on keeping things this way; for that purpose we need to steadily enhance the quality and the reliability of our method even under difficult (for example geological) conditions. And we think that this congress programme will contribute some important input.

I am looking forward to meeting you in Dordrecht and wish us all a beautiful summer and successful HDD projects until then.

Yours sincerely,

Marc Schnau

Vorwort

Sehr geehrte Damen und Herren, liebe Mitglieder des DCA,

in meinem neuen Amt darf ich Sie zum ersten Mal an dieser Stelle zu unserem DCA-Jahreskongress einladen. Ich würde mich sehr freuen, Sie vom 04. – 06. Oktober 2017 in der niederländischen Stadt Dordrecht in der Provinz Südholland begrüßen zu dürfen. Mit dem Erwerb der Stadtrechte im Jahr 1220 ist Dordrecht die älteste Stadt des ehemaligen Hollands und die zweitälteste der Niederlanden. Südöstlich von Rotterdam gelegen und inmitten verzweigter Flußlandschaften bietet Dordrecht eine malerische Atmosphäre mit historischen Binnenstadthäfen und zahlreichen Baudenkmälern.

Wir hoffen Sie auch mit der Aussicht auf ein schönes Ambiente dieser Veranstaltung zu einer Teilnahme an unserem Kongress bewegen zu können. Wenngleich das anliegende Vortragsprogramm hoffentlich nicht minder Ihr Interesse weckt. An dieser Stelle möchte ich mich bei allen herzlich bedanken, die an der Programmgestaltung mitgewirkt haben bzw. als Vortragende noch mitwirken werden, sowie bei einer erfreulich großen Anzahl von Sponsoren.

Das Leitthema unserer diesjährigen Jahrestagung lautet „HDD First“ – kurz und simpel. Wer eine Parallele zu einem kritisch diskutierten amerikanischen Wahlkampfslogan erkennt, mag nicht ganz falsch liegen. Im Gegensatz zur Politik ist der DCA als Vertreter von wirtschaftlich operierenden Unternehmen allerdings eher legitimiert bzw. auch in der Pflicht die Interessen seiner Mitglieder besonders in den Vordergrund zu stellen.

HDD First – im Bereich der grabenlosen Rohrverlegeverfahren ist HDD die meist verwendete und effizienteste Bauweise. Wir wollen daran arbeiten, dass dies auch so bleibt und müssen dafür die Qualität und Zuverlässigkeit des Verfahrens auch unter schwierigen (z.B. geologischen) Bedingungen stetig weiter entwickeln. Wir denken, dass unser Programm hierzu einen Beitrag liefern wird.

Ich freue mich auf Sie in Dordrecht und wünsche uns bis dahin noch schöne Sommertage und erfolgreiche HDD-Projekte.

Ihr

Marc Schnau

Topic: HDD-First

Program:

Wednesday, 04th of October 2017

11.30 – 18.00	**„Check in“ at** hotel van der Valk Dordrecht
13.00	**Lunch at hotel van der Valk**
14.30	**Discover Dordrecht**
19.30	**„Cocktail reception”** sponsored by van der Valk hotel
20.00	**Dinner at hotel van der Valk (Live Cooking)**

Thursday, 05th of October 2017

09.00	**Welcome** Dipl.-Geol. Dietmar Quante – Geschäftsführer DCA-Europe
09.15	**Welcome** Dipl.-Ing. (FH) Marc Schnau - President DCA-Europe
09.30	**Horizontal Directional Drilling - Design and construction over the years: 1980 - present** Ir. H. J. Brink, N.V. Nederlandse Gasunie
10.15	**Development of the offshore wind industry** Willem Smelik, Meewind, Niederlande
11.00	**Coffee break**
11.20	**HDD link for 60 million users** Alexandre Cambier, HDI
12.00	**„OMG”** John Doe, DCA
12.45	**Lunch at hotel van der Valk**
14.30	**„HDD Trouble-shooting“ - Panel discussion (Part 1)** Moderator: Dipl.-Ing. F.-J. Kissing, Open Grid Europe

15.30 **Coffee break**

15.50 **„HDD Trouble-shooting“ - Panel discussion (Part 2)**
Moderator: Dipl.-Ing. F.-J. Kissing, Open Grid Europe

16.30 **Summary - outlook**

18.50 **Meeting Hotel Lobby – Transfer by bus**

19.30 **Cocktail reception at Steam Ship de Rotterdam**

20.00 **Dinner at the Steam Ship de Rotterdam**

Friday, 06th of October 2017

09.00 **Everything you wanted to know about wire line steering systems – but where afraid to ask**
Dan Billig, Prime Horizontal
Craig Rowney, Inrock International LTD

09.40 **Contractual Risk Management of HDD Projects**
J. Kevin Mullins, Barrister-at-Law,
JKM Contract Management Consultancy b.v.

10.20 **Coffee break**

10.45 **Danube River Crossing - Geotechnic (Part 1)**
Dr. Christoph Donie, Dr. Donié Geo-Consult GmbH

11.30 **Danube River Crossing - Execution HDD (Part 2)**
Dipl.-Ing. Günter Kruse, LMR Drilling GmbH

12.15 **Everything you always wanted to know about drill pipe, but were afraid to ask**
Thorn C. Huffman, Tiger Trading Inc.

12.45 **End of program**

13.00 **Lunch at hotel van der Valk hotel**

Tagungsthema: „HDD-First“

Programm

Mittwoch, 04. Oktober 2017

11.30 – 18.00 Uhr	**„Check in“** Hotel van der Valk, Dordrecht
13.00 Uhr	**Mittagessen im Hotel van der Valk**
14.30 Uhr	**Discover Dordrecht**
19.30 Uhr	**„Cocktail reception”** gesponsert vom Hotel van der Valk
20.00 Uhr	**Abendessen im Hotel van der Valk (Live Cooking)**

Donnerstag, 05. Oktober 2017

09.00 Uhr	**Begrüßung** Dipl.-Geol. Dietmar Quante – Geschäftsführer DCA-Europe
09.15 Uhr	**Begrüßung** Dipl.-Ing. (FH) Marc Schnau - Präsident DCA-Europe
09.30 Uhr	**Gesteuerte Horizontalbohrtechnik -** **Planung und Ausführung in der Retrospektive: 1980 – bis heute** Ir. H. J. Brink, N.V. Nederlandse Gasunie
10.15 Uhr	**Entwicklung der Offshore-Windenergie Industrie** Willem Smelik, Meewind, Niederlande
11.00 Uhr	**Kaffeepause**
11.20 Uhr	**„HDD link“ für 60 Millionen Nutzer** Alexandre Cambier, HDI
12.00 Uhr	**„OMG”** Max Mustermann, DCA
12.45 Uhr	**Mittagessen im Hotel van der Valk**
14.30 Uhr	**Podiumsdiskussion** **„HDD Trouble-shooting“- (Teil 1)** Moderator: Dipl.-Ing. F.-J. Kissing, Open Grid Europe

15.30 Uhr	**Kaffeepause**
15.50 Uhr	**Podiumsdiskussion** **„HDD Trouble-shooting“ - (Teil 2)** Moderator: Dipl.-Ing. F.-J. Kissing, Open Grid Europe
16.30 Uhr	**Fazit - Ausblick**
18.50 Uhr	**Treffpunkt Hotel Lobby - Bustour zur Abendveranstaltung**
19.30 Uhr	**„Cocktail reception” auf dem Steam Ship de Rotterdam**
20.00 Uhr	**Abendessen auf dem Steam Ship de Rotterdam**

Freitag, 06. Oktober 2017

09.00 Uhr	**Alles was man über Wireline Steuerungssysteme bei HDD wissen möchte, aber sich nie getraut hat zu fragen?** Dan Billig, Prime Horizontal Craig Rowney, Inrock International LTD
09.40 Uhr	**Risikomanagement bei HDD-Projekten** J. Kevin Mullins, Barrister-at-Law, JKM Contract Management Consultancy b.v.
10.20 Uhr	**Coffee break**
10.45 Uhr	**Kreuzung des Danube Flusses - Geotechnik (Teil 1)** Dr. Christoph Donie, Dr. Donié Geo-Consult GmbH
11.30 Uhr	**Kreuzung des Danube Flusses - HDD Ausführung (Teil 2)** Dipl.-Ing. Günter Kruse, LMR Drilling GmbH
12.15 Uhr	**Alles was man über Bohrstangen bei HDD wissen möchte, aber sich nie getraut hat zu fragen?** Thorn C. Huffman, Tiger Trading Inc.
12.45 Uhr	**Tagungsende**
13.00 Uhr	**Mittagessen im Hotel van der Valk**

Normag develops and produces high quality systems for the Tunneling and Horizontal Drilling Industry. The company uses innovative technology based on many years
of practical experience in the development and construction of HDD installations.

Main scopes in engineering are compact installations with high capacity, modular with best on market rig-up time, low environmental impact, low costs of ownership and high safety levels.
Normag manufactures installations both in series as well as custom-build. We offer packages where performance and capacities of various models match perfectly.
Recently our portfolio has been enlarged with two models of HDD rigs. These direct electric driven rigs have economical advantages as well as lower environmental impact, e.g. by reducing noise level.
Our solid control systems meet CSC certification and are therefore worldwide transportable on sea-going vessels.
Our customers are mainly HD drilling and tunneling contractors, some of our customers work on shore as well as offshore.

Normag entwickelt und produziert hochwertige Systeme für den Tunnelbau und die Horizontalbohrindustrie. Das Unternehmen nutzt innovative Technologien auf der Basis langjähriger Erfahrung in der Entwicklung und dem Bau von HDD Equipment.

Hauptkompetenzen der Ingenieurtätigkeit sind kompakte Anlagen mit hoher Kapazität, modularer Bauweise mit den kürzesten Auf- und Abbauzeiten, geringe Umweltbelastung, niedrige Betriebskosten und ein hohes Sicherheitsniveau.
Normag stellt sowohl hochwertiges Standardequipment als auch nach Kundenwunsch maßgeschneiderte Anlagen her. Wir bieten Gesamtpakete an, bei denen Leistung und Kapazitäten verschiedener Modelle perfekt zueinander passen.
Vor kurzem hat Normag das Portfolio um 2 komplett elektrisch betriebene HDD Bohranlagen erweitert. Gegenüber herkömmlich angetriebenen Geräten bieten diese Bohranlagen deutliche ökonomische Vorteile im laufenden Betrieb bei gleichzeitiger Reduzierung der Umweltbelastung, z.B. durch die sehr geringe Lärmimmission.
Unsere Feststoffkontrollsysteme sind nach CSC-Anforderungen zertifiziert und können weltweit auf Seeschiffen transportiert werden.
Zu unseren Kunden gehören namhafte Firmen aus der HDD-Industrie und dem Tunnelbau. Die Normag Anlagen werden von diesen sowohl on-shore als auch offshore eingesetzt.

Deltares

Enabling Delta Life

Deltares is an independent institute for applied research in the field of subsurface and water. Throughout the world, we work on smart solutions, innovations and applications for people, environment and society. Our main focus is on deltas, coastal regions and river basins. Managing these densely populated and vulnerable areas is complex, which is why we work closely with governments, businesses, other research institutes and universities at home and abroad. As an applied research institute, it is our goal that our expert knowledge can be used in and for society. For Deltares the quality of our expertise and advice comes first.

Knowledge is our core business

All contracts and projects, whether financed privately or from strategic research budgets, contribute to the consolidation of our knowledge base. Furthermore, we believe in openness and transparency, open source works, is our firm conviction. Deltares employs over 800 people and is based in Delft and Utrecht.

Visser & Smit Hanab

Delivering Energy

Over one hundred years of experience and a proven record of service. Visser & Smit Hanab is a specialist in above-ground and underground pipelines and cable infrastructure.

We develop, build and maintain links, networks and installations for water, energy, chemical and petrochemical production. Connection is in our DNA. And, we believe in making connections not only between pipelines and cable networks, but also with our clients. Joining together for a sustainable society. Core values in all of our projects: safety, integrity, quality and professionalism.

Visser & Smit Hanab's work terrain covers the development, engineering, construction and maintenance of above-ground and underground cable and pipeline networks and associated installations for energy, water, chemical and petrochemical production.

An impressive number of national and international projects and a proven record of service. With over a century of experience, Visser & Smit Hanab is a trusted name in the industry.

Vermeer

EQUIPPED TO DO MORE.

As an industrial and agricultural equipment company, Vermeer Corporation manufactures machines that make a real impact in a progressing world. Vermeer offers customers a full line of high-quality underground construction, surface mining, tree care, environmental and agricultural equipment. Vermeer machines carry a reputation for being built tough, built to perform and built for value.

Headquartered in Pella, Iowa, U.S.A., with affiliated companies and independent dealer locations around the world, Vermeer is committed to meeting customers' needs in more than 60 nations. Those customers are at the core of the business and supported by reliable, localized customer service and support provided by independent dealers. That support has been part of the culture at Vermeer for more than six decades.

Find more information about Vermeer Corporation, product lines, the dealer network and financing options by visiting **vermeer.com.**

Als ein Produzent von landwirtschaftliche und Industrie Maschinen, macht Vermeer Corporation einen „Real impact" in die vorschreitende Welt. Vermeer bietet eine vollständige hochwertige Produkt Palette für Tiefbau, Tagebau, Gala Bau, Umwelt Technik und Landwirtschaft. Vermeer steht für Robust, Leistung und Wert Festigkeit .

Der Hauptsitz ist in Pella, Iowa, Vereinigten Staaten, mit einem internationalen unabhängiges Händler Netzwerk ist Vermeer seine Kunden in über 60 Länder gewidmet. Diese Kunden sind die „core business" , unterstutzt durch zuverlässiger Service vor Ort, versorgt durch unabhängige Händler. Diese Unterstützung ist Teil der Vermeer Kultur seit mehr als Zechs Dezennien.

Mehr Information über Vermeer Corporation, Produkte, Handler Netzwerk und Finanzierung finden sie auf **vermeer.com**

egeplast

egeplast – Pipe systems safeguarding future generations

egeplast is a highly innovative manufacturer of plastic pipe systems which has been setting standards for decades. Clients in more than 40 countries place their trust in egeplast consulting solutions and quality products for the transportation of water, gas and data. The customer portfolio of the owner-managed company includes some of the biggest and most challenging utility companies and network operators worldwide.

The products ensure the highest level of investment security. The main emphasis is on intelligent pipe systems for trenchless installation and rehabilitation methods. The SLM® 3.0 protective pipe system ensuring damage-free installation using alternative installation techniques guarantees a long life and efficiency for the network operator. It is also available as an SLM® DCT version featuring integrated quality monitoring for closed-trench installation. The SLA® Barrier Pipe is permeation-tight to protect drinking water and the environment. The 3L safety pipe system is a permanently monitored pipe system detecting and reporting damages. The HexelOne® SLM High-Pressure Pipe System is a DVGW-certified self-reinforced high-pressure pipe made of PE and can also be used for trenchless installation thanks to its protective layer and inner layer made of PE 100-RC.

To complement the pipes for every application, the egeplast product range includes matching egeFit® fittings and thus complete pipe systems from a single source.

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egeplast - zukunftssichere Rohrsysteme

egeplast ist ein hochinnovativer und seit Jahrzehnten Maßstäbe setzender Hersteller von Kunststoffrohrsystemen. Kunden in über 40 Ländern vertrauen auf Beratungslösungen und Qualitätsprodukte von egeplast für den Transport von Wasser, Gasen und Daten. Unter den Kunden des inhabergeführten Unternehmens befinden sich einige der größten und anspruchsvollsten Versorgungsunternehmen und Netzbetreiber weltweit.

Die Produkte bieten höchste Investitionssicherheit. Den Schwerpunkt bilden intelligente Rohrsysteme für die grabenlosen Verlege- und Sanierungsverfahren. Das SLM® 3.0 Schutzmantelrohrsystem für einen beschädigungsfreien Einbau mittels alternativer Verlegetechniken sichert dem Netzbetreiber Langlebigkeit und Wirtschaftlichkeit. Es ist auch als SLM® DCT mit integrierter Qualitätsprüfung bei geschlossener Bauweise erhältlich. Das SLA® Barrier Pipe ist permeationsdicht zum Schutz von Trinkwasser und Umwelt. Das 3L Sicherheitsrohrsystem ist ein permanent überwachtes Rohrsystem, das Schäden findet und meldet. Das HexelOne® SLM Hochdruck-Rohrsystem ist ein DVGW-zertifiziertes eigenverstärktes Hochdruckrohr aus PE und dank Schutzmantel und Innenschicht aus PE 100-RC grabenlos verlegbar.

Zu den Rohren für jede Anwendung bietet egeplast darauf abgestimmte egeFit® Formteile und damit komplette Rohrsysteme aus einer Hand.

Baroid Industrial Drilling Products (Baroid IDP), product service line, is an international network of sales and service engineers, laboratory scientists, and support personnel dedicated to servicing all facets of the non-oil well drilling industries. Baroid Industrial Drilling Products supplies a comprehensive line of drilling, grouting, plugging, abandonment and well rehabilitation and well development products specifically engineered to optimize performance and cost effectiveness to end-users in wide ranging and diverse markets.
Baroid IDP sales and service engineers average over 20 years' experience in several facets of the drilling industry. These individuals bring a comprehensive knowledge of products, drilling methods, regulations and equipment to help customers solve the toughest drilling problems facing your industry. IDP personnel can help in all areas of the drilling project. From product selection through well completion, Baroid IDP representatives are known for being there for the customer.

Baroid Industrial Drilling Products (Baroid IDP), Produkt Service Linie, ist ein internationales Netzwerk von Verkauf und Service Ingenieuren, Labor-Wissenschaftlern und Support Personal welche alle Bereiche der nicht Öl-Bohrindustrie abdecken. Baroid Industrial Drilling Products liefert eine umfassende Palette von Bohr-, Injektions-, Abdichtungs-, Brunnenrehabilitations und Brunnenentwicklungsprodukten, welche speziell für die Optimierung der Leistungs und Wirtschaftlichkeit für die Endnutzer in weiten und vielfältigen Märkten entwickelt wurden.
Baroid IDP Verkauf und Service Ingenieure haben mehr als 20 Jahre Erfahrung in allen Bereichen der Bohrindustrie. Diese Personen bringen ein umfassendes Wissen über Produkte, Bohrmethoden, Vorschriften und Ausrüstung mit um den Kunden zu helfen die schwierigsten Probleme zu lösen die bei Bohrungen auftreten. IDP Mitarbeiter können in allen Bereichen des Bohrprojekts helfen. Von der Produktauswahl bis zur Fertigstellung sind die Baroid IDP Mitarbeiter dafür bekannt, dass sie für den Kunden da sind.

The **DrillGuide** steering tool is the most advanced navigation and guidance system on the market. After years of experience with magnetic steering tools, Brownline developed the GST using new technologies, in which gyroscopes play an important role.

The DrillGuide GST is the most accurate of all present day drilling navigation and guidance systems. It gives the drilling contractor the highest possible certainty to position the bore hole as required in the shortest possible time, with the highest level of accuracy

Company overview Gebr. Van Leeuwen Boringen B.V. (GvL) "Where innovation is tradition"
Gebr. Van Leeuwen Boringen B.V. is a Dutch firm which specializes in trenchless installation of pipelines and cables. Since its establishment in 1969, Van Leeuwen provides subsurface construction solutions for the installation of infrastructural networks, conduits to carry electric cables and pipelines for carrying (sewage) water, gas, oil and other products. Next to the installation of pipes, conduits and cables onshore, the firm specializes in shore crossings and landfalls. Through the years the company has built an extensive track record in the installation of pipes and cables under roads, railroads, waterways, dikes, buildings and other underground infrastructural networks in different types of soil conditions, varying from soft soil conditions to rocky areas.
GvL has gained wide experience in providing a complete range of services, from design and engineering to as-build delivery of trenchless routing projects, in support of governments, municipalities, (civil) contractors, electrical companies and oil & gas companies. In addition, the firm has experience in working under different types of contracts, varying from unit-base rate contracts to turn key contracts.
The GvL company is driven by a true hands-on mentality, were innovation and problem-solving thinking are the firm's core business drivers. Each trenchless routing project is known by its own characteristics for which van Leeuwen provides a specific, tailor-made solution. In sum, a reliable and professional partner for any trenchless routing project!

Areas of expertise
Van Leeuwen's major areas of expertise on trenchless techniques for the installation of cables and pipes include:
Horizontal Directional Drilling (HDD)
Direct Drill® (DD)
Micro tunnelling and pipe jacking

Gasunie is a European gas infrastructure company. We provide the transport of natural gas and green gas in the Netherlands and the Northern part of Germany.

Gas is an important source of energy in north-west Europe. To get the gas to the end-user safely and reliably, we have a high-grade gas transmission grid. Our customers use this grid to transport gas on to end-users and some end-users are directly connected to the grid.

Activities of Gasunie

All our activities are geared to facilitating the market, both the industrial and the domestic gas markets, in the Netherlands, Germany and further afield. This varies from providing gas transport to constructing new infrastructure, from participating in new projects to developing new services. In all our activities we follow trends and requirements in the market closely. Our aim is to be able to offer our customers the best standard of service possible.

Gasunie has two subsidiaries that manage the gas transmission grid: Gasunie Deutschland in Germany and Gasunie Transport Services (GTS) in the Netherlands.

We also provide the market with gas storage facilities (EnergyStock), the pipeline to England (BBL) and the LNG terminal Gate at Maasvlakte. In addition, we facilitate and stimulate the green gas market through our subsidiary Vertogas. Producers and traders in green gas can use Vertogas for certification of their green gas.

Roadbook

22th DCA-Europe Annual Congress Dordrecht 2017

Congress Program

Wednesday

Date	Time	Activity	Information
Wednesday, 04th of October 2017	11.30-18.00	Check-in at hotel Van der Valk, Laan van Europa 1600, 3317 DB Dordrecht, Netherlands	The rooms are free at 14.00. Luggage can be left in a separate room. Check in is at the 2nd floor
	13.00	Lunch at hotel Van der Valk	Lunch is scheduled in the restaurant
	14.40	Meeting at the reception of hotel Van der Valk	
	14.30	Discover Tour Dordrecht	Travel by bus to Dordrecht, two german and one english speaking group
	18.00	End of Sightseeing tour	Travel back by bus to hotel
	19.30	"Cocktail reception" sponsored by hotel Van der Valk	The reception is scheduled in the skybar of the hotel
	20.00-23.00	Dinner at hotel Van der Valk, afterwards Hotel bar	Dinner is scheduled in the room Biesbosch 2

Roadbook

22th DCA-Europe Annual Congress Dordrecht 2017

Congress Program

Thursday

Date	Time	Activity	Information
Thursday, 05th of October 2017	09.00	Congress Meeting	Meeting room Biesbosch 1
	12.45	Lunch at hotel Van der Valk	Lunch is scheduled in the restaurant
	14.30	„HDD Trouble shooting“ – Panel discussion (Part 1)	Meeting room Biesbosch 1
	15.30	Coffee break	
	15.50	„HDD Trouble shooting“ – Panel discussion (Part 2)	Meeting room Biesbosch 1
	18.50	Meeting at hotel lobby for departure	Travel by bus to SS Rotterdam, Adress: 3e Katendrechtse Hoofd 25, 3072 AM Rotterdam
	19.30	“Cocktail reception” sponsored by SS Rotterdam	The reception is scheduled in the Smoking room
	20.00-00.00	Dinner at SS Rotterdam	Dinner is scheduled in the Grand Ballroom
	00.00	End of Event	Transfer by bus to hotel van der Valk; afterwards hotel bar

Roadbook

22th DCA-Europe Annual Congress Dordrecht 2017

Companion Program

Thursday

Date	Time	Activity	Information
Thursday, 05th of October 2017 - Companion Program	08.50	Meeting a the hotel lobby	
	09.00	Trip to Kinderdijk	Travel by bus
	09.30	Bootrip to the windmills of Kinderdijk	
	11.40	Lunch at a restaurant in Dordrecht	Travel by bus
	13.30	Walking tour to "De Proefkamer na Rutte & Zn"	Short walking tour, depends on the weather conditions
	13.45-16.30	Workshop liqueur making	
	16.45	End of Tour	Transfer by bus to hotel van der Valk

Roadbook

22th DCA-Europe Annual Congress Dordrecht 2017

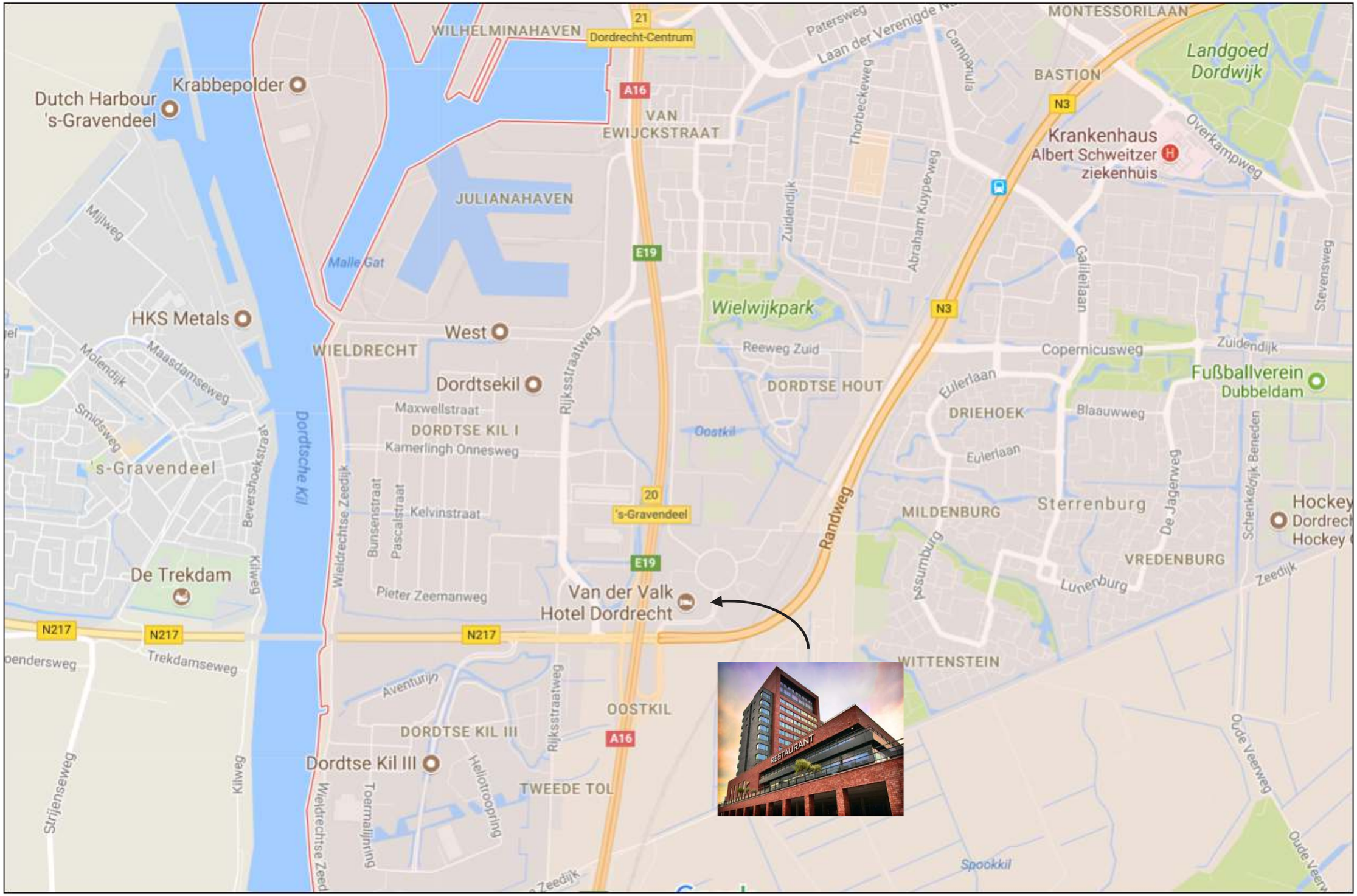
Congress Program

Friday

Date	Time	Activity	Information
Friday , 06th of October 2017	until 12.00	Ckeck-out	
	09.00	Congress Meeting	Meeting room Biesbosch 1
	12.45	End of congress	
	13.00	Lunch at hotel Van der Valk	Lunch is scheduled in the restaurant
	13.00	Golt Tournament	Golf chairman, Johan Smit, TDC

Further information:
Executive secretary: Dietmar Quante: +49 (0) 175 - 5267801

Citymap


WILHELMINAHAVEN
21
Dordrecht-Centrum
Krabbepolder
Dutch Harbour
's-Gravendeel
A16
VAN
EWIJCKSTRAAT
JULIANAHAVEN
Malle Gat
E19
Patersweg
Laan der Verenigde
Campanula
Thorbeckeweg
Zuidendijk
Abraham Kuyperweg
MONTESSORILAAN
BASTION
N3
Landgoed
Dordwijk
Overkampweg
Krankenhaus
Albert Schweitzer
ziekenhuis
Mijlweg
HKS Metals
West
WIELDRECHT
Wielwijkpark
Reeweg Zuid
Galileilaan
Stevensweg
Copernicusweg
Zuidendijk
Fußballverein
Dubbeldam
Molendijk
Maasdamseweg
Smidsweg
Dordtsekil
Maxwellstraat
DORDTSE KIL I
Kamerlingh Onnesweg
Rijksstraatweg
DORDTSE HOUT
Eulerlaan
DRIEHOEK
Blaauwweg
Oostkil
's-Gravendeel
Beversluisstraat
Dordtsche Kil
Wieldrechtse Zeedijk
Bunsenstraat
Pascalstraat
Kelvinstraat
20
's-Gravendeel
Randweg
MILDENBURG
Sterrenburg
De Jagerweg
Schenkeldijk Beneden
Hockey
Dordrecht
Hockey
E19
VREDENBURG
Lunenburg
Zeedijk
De Trekdam
Kilweg
Pieter Zeemanweg
Van der Valk
Hotel Dordrecht
Assumburg
N217
N217
N217
Trekdamseweg
WITTENSTEIN
Aventurijn
OOSTKIL
DORDTSE KIL III
A16
Dordtse Kil III
Rijksstraatweg
Hellotrooping
Toermalijnring
TWEEDE TOL
Strijenseweg
Kilweg
Oude Veerweg
Spookkil
RESTAURANT

Teilnehmer der Jahrestagung 2017:

	Nachname	Vorname	Firma	Unterschrift
1	Albert	René	Vermeer	
2	Beermann	Ewald	Beermann Bohrtechnik GmbH	
3	Beermann	Steffen	Beermann Bohrtechnik GmbH	
4	Bernhardt	Kai	Tracto-Technik GmbH & Co. KG	
5	Bettendorf	Hubertus	Prime Drilling GmbH	
6	Billig	Dan	Prime Horizontal	
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9	Brink	H. J.	N.V. Nederlands Gasunie	
10	Buhr	Gertrud	Steffel KKS GmbH	
11	Buhr	Klaus-Dieter	Steffel KKS GmbH	
12	Bunge	Sven	BTW Bohrtec-Teubner Wittenberg GmbH	
13	Butterworth	Jack	LMR Drilling GmbH	
14	Cambier	Alexandre	Horizontal Drilling International SA (H.D.I.)	
15	Chirulli	Renzo	Vermeer	
16	Clark	Ben	Derrick Equipment Company	
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30	Gardner	Barry	LMR Drilling UK Ltd.	
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32	Gottschalk	Stefan	AMC Europe GmbH	
33	Greve	Herrmann	Bau-ABC Rostrup	
34	Groeneveld-Hoogendijk	Marja	Visser & Smit Hanab bv	
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42	Irmscher	Simone	FMBE GmbH	
43	Jatzko	Boris	Ditch Witch International - Barcelona	
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45	Kandora	Alexander	Vermeer Deutschland GmbH	
46	Kißing	Franz-Josef	Open Grid Europe GmbH	
47	Knopf	Oliver	Phrikolat Drilling Specialties GmbH	
48	Koll	Ralf	N.V. Nederlands Gasunie	
49	Krüger	Mareike	Hermann Kahnenbley Lohnunternehmen	
50	Kruse	Günter	LMR Drilling GmbH	
51	Kruse	Henk M.G.	Deltares	
52	Lang	Sebastian	Bohrservice Rhein-Main Gesellschaft für Horizontalbohrungen mbH	
53	Lang	Fritz Eckard	Bohrservice Rhein-Main Gesellschaft für Horizontalbohrungen mbH	
54	Langenbach	Monika	Salzgitter Mannesmann Line Pipe GmbH	
55	Laubach	Nicole	L-Team Baumaschinen GmbH	

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57	Lauter	Irmhild	Phrikolat Drilling Specialties GmbH	
58	Lesniak	Rafal	Heads Sp. Zo.o.	
59	Lewis	David	Inrock International LTD	
60	Lubberger	Michael	Herrenknecht AG	
61	Lübbers	Hermann	Beermann Bohrtechnik GmbH	
62	Marschall	Chris	AMC Europe GmbH	
63	Mataré	Till	Bohrservice Rhein-Main Gesellschaft für Horizontalbohrungen mbH	
64	Mathy	Philippe	Horizontal Drilling International SA (H.D.I.)	
65	Moll	Günter	MOLL-prd GmbH & Co. KG Planungsgesellschaft für Rohrvortrieb und Dükerbau	
66	Mücke	Timo	Beermann Bohrtechnik GmbH	
67	Muhl	Jürgen	Step Oiltools GmbH	
68	Müller	Corinna	Transco Downhole Drilling Tools GmbH	
69	Müller	Dirk	Transco Downhole Drilling Tools GmbH	
70	Mullins	J. Kevin	JKM Contract Management Consultancy B.V.	
71	Nachtigall	Jean-Marie	AMC Europe GmbH	
72	Neubauer	Holger	IBZ Neubauer GmbH & Co. KG	
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97	Schütze	Gregor	FMBE GmbH	
98	Schütze	Simone	FMBE GmbH	
99	Seamans	Elain	LMR Drilling UK Ltd.	
100	Seamans	Jeremy	LMR Drilling UK Ltd.	
101	Seyrich	André	IBZ Neubauer GmbH & Co. KG	
102	Simm	Manuel	Salzgitter Mannesmann Line Pipe GmbH	
103	Smelik	Willem	Meewind	
104	Smit	Johan	TDC Technical Duroplastic Constructions GmbH	
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114	van Dompselaar	Jarno	Cebo Holland B.V.	
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117	Weishaupt	Andreas	Ingenieurbüro Weishaupt	
118	Weishaupt	Teresa	Ingenieurbüro Weishaupt	
119	Willemsen	Corné	SiteTec B.V.	
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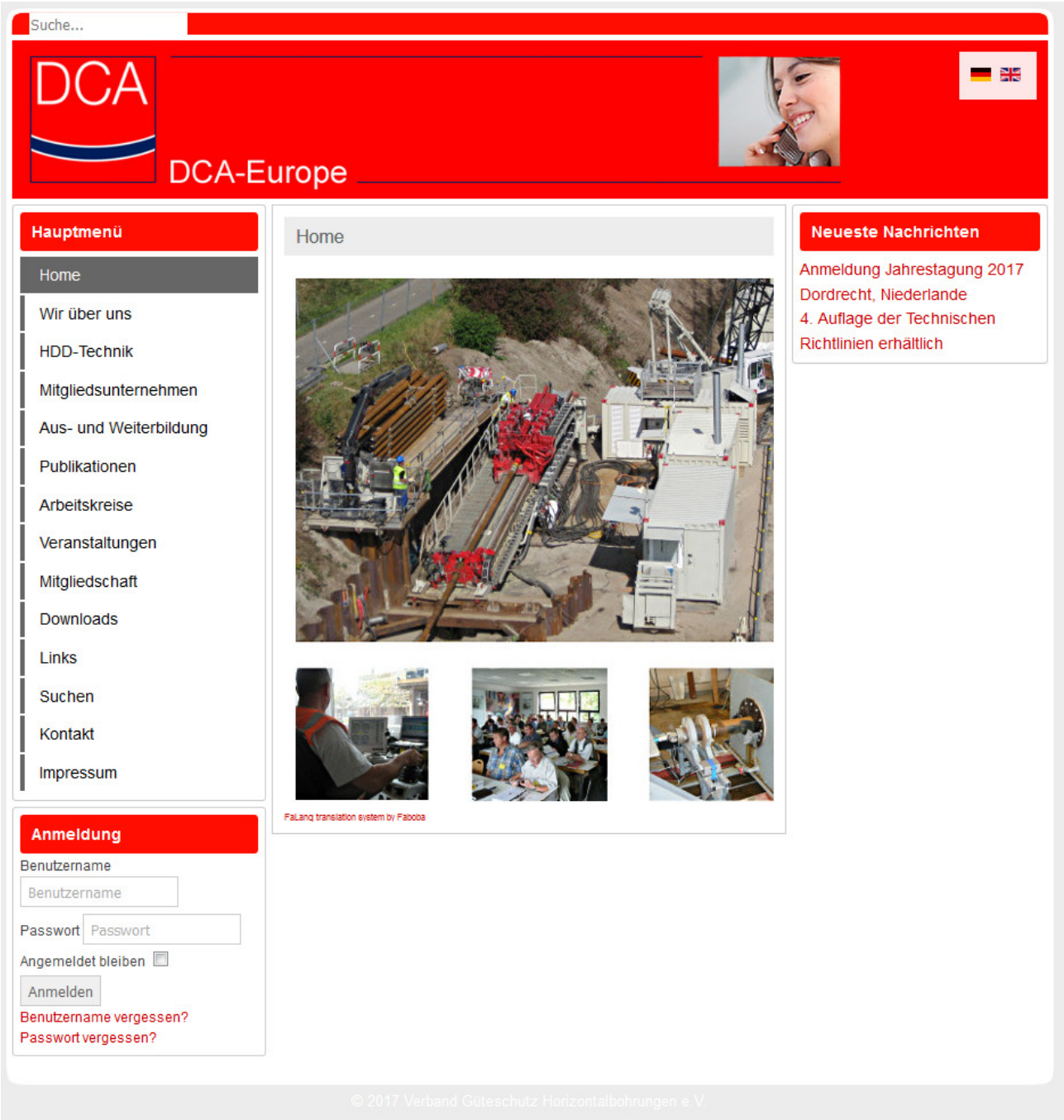

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Welcoming

Dear Mr. President,
My dear Ladies and Gentlemen,

I would like to welcome you to the **22nd annual congress of the Drilling Contractors Association (DCA)** here at the Van der Valk Hotel in Dordrecht, a city full of history.

I am especially glad to state that this annual congress here in Dordrecht is again very well attended by more than 120 participants, like our outing to Hamburg last year. Therefore I wish to thank all of you on behalf of the board members for your coming!

When the board members had to determine the venue of our annual congress in 2017, they chose Dordrecht in the Netherlands. Imbedded in a picturesque landscape in the province South Holland, this city full of history has about 120,000 inhabitants and is located at one of Europe's highest frequented river intersections. The arm of the Rhine arm Beneden Merwede separates into Kanal Noord, Oude Maas and Dordtsche Kil surrounding Dordrecht. The town received city rights in 1220; this makes Dordrecht the eldest city in former Holland. The position was of strategic value and from the year 1299 turned the city into an important trade centre. Merchandise then was wine, wood and cereals. Several times the Hanseatic League successfully managed to politically pressure the trade centre Brügge and its base Dordrecht. In 1421 came the Saint Elisabeth's flood and inundated large parts of South Holland, causing Dordrecht to become an island. Representatives of nearly all cities in Holland convened in Dordrecht on July 15-16, 1572 at the building "Het Hof". They recognised William of Orange as their official leader and declared their independence from Spain.

Being independent and at the same time European is also the foundation of the DCA. Founded in Düsseldorf in 1994 as "Verband Güteschutz Horizontalbohrungen e.V.", better known beyond Germany as Drilling Contractors Association or in Francophonic areas as "Association des Entrepreneurs de Forage Dirigé", the DCA stands for an independent European association representing the interests of its members across all borders. The association is neither German, nor Dutch, nor French - it is European. Promoting and further educating the HDD technology per se is always in the focus of any doing and acting!

Steadily fine-tuning the contents of the Technical Guidelines in three languages, organising expert congresses at annually alternating venues in Germany, the Netherlands, Belgium, France, Great Britain and maybe in another European country in 2019, continuous international exchange of experiences at expert panels, task groups and in matters of training and further education - these are just some issues that distinguish this association as transnational interactive European organisation. Nevertheless and time and again we have to advocate joint work and cooperation. The board calls upon each of you, play your part and actively help implementing our mutual objectives.

Like Marseille and Hamburg before, the venue Dordrecht is located at a European point of intersection that enables ties between people from other nations. Let us use the opportunity and establish such ties in the next few days here in Dordrecht. We can find new mutual connecting factors in terms of our HDD technology.
Let us return to this congress and have a look at the programme of the next two days.

I wish to welcome all lecturers of this year. First let me welcome Mr. Ir. H. J. Brink of the N.V. Nederlandse Gasunie. Mr. Brink will open this congress with his lecture about “directional horizontal drillings - planning and performance retrospectively from 1980 until today”. Welcome to you!
Right afterwards Mr. Willem Smelk of Meewind will hold a lecture about “developments in the offshore wind energy industry”. Mr. Smelk, welcome to Dordrecht as well!
And I cordially welcome all members of the DCA, and in particular our new ones, of course. Welcome in the DCA family!
As cordially I welcome the new president of the Rohrleitungsbauverband, the association of piping companies, Mr. Fritz Eckard Lang coming from our long-term member Bohrservice Rhein-Main Gesellschaft für Horizontalbohrungen mbH in Bodenheim. Mr. Lang, welcome to you!
I welcome our guests who want to take the opportunity of this congress in Dordrecht to be informed about latest developments in the HDD technology and make new contacts in this industry. I welcome you as well!

The two lectures I mentioned already will be followed by the one of Mr. Alexandre Cambier of HDI who will talk about ”HDD link for 60 million users“. Subsequent our vice-president Jorn Stoelinga of Visser & Smit Hanab bv will inform us in his lecture “Oh my God”, thus giving a first glimpse of the panel discussion this afternoon, titled “trouble shooting”. You can look forward to this discussion presented by Mr. Kissing of Open Grid Europe after lunch break.
On tomorrow’s Friday we will hear interesting lectures about current HDD projects and other issues around our industry as usual. Apart from the lecture by Mr. Billig and Mr. Rowney about “everything you always wanted to know about wireline control systems in HDD but were afraid to ask“, Mr. Huffman will report about “everything you always wanted to know about drill pipes in HDD but were afraid to ask”. In between information will be provided about “risk management at HDD projects” by Mr. Mullins, and about the “crossing of the Danube”, part 1 geotechnique by Mr. Donié, part 2 HDD performance by Mr. Kruse.

Concluding my short introduction I wish you and all of us some interesting and top-class lectures, open and critical discussions and all in all an eventful stay in beautiful Dordrecht.

Yours,

Dipl.-Geol. Dietmar Quante
DCA - Executive Secretary

Begrüßung

Sehr geehrter Herr Präsident,
meine sehr verehrten Damen und Herren, Ladies and Gentlemen,

ich möchte Sie alle recht herzlich zur **22. Jahrestagung des Verbandes Güteschutz Horizontalbohrungen e.V. (DCA)** hier in der geschichtsträchtigen Stadt Dordrecht im Van der Valk Hotel begrüßen.

Ich freue mich besonders, dass auch diese Jahrestagung hier in Dordrecht nach unserem letztjährigen Ausflug nach Hamburg mit über 120 Teilnehmern wieder sehr gut besucht ist. Im Namen des Vorstandes möchte ich mich daher recht herzlich bei Ihnen allen für Ihr Kommen bedanken!

Bei der Wahl des Tagungsortes für unsere Jahrestagung 2017 hat sich der Vorstand für Dordrecht in den Niederlanden entschieden. Eingebettet in die reizvolle Lage in der Provinz Süd-Holland, liegt der geschichtsträchtige Ort mit rd. 120.000 Einwohnern inmitten eines der am stärksten befahrenen Flussschnittpunkte Europas. Um Dordrecht herum teilt sich der Rheinarm Beneden Merwede in den Kanal Noord, die Oude Maas und den Dordtsche Kil. Dordrecht erhielt seine Stadtrechte 1220, womit die Stadt die älteste im ehemaligen Holland ist. Die strategisch wertvolle Lage der Stadt machte sie ab dem Jahr 1299 zu einem wichtigen Handelszentrum. Handelsgüter am Orte waren Wein, Holz und Getreide. Die Hanse wusste das Handelszentrum Brügge mit dem Standort Dordrecht mehrfach politisch erfolgreich unter Druck zu setzen. 1421 wurden mit der Sankt-Elisabeth-Flut große Teile Südhollands überflutet, wodurch Dordrecht zur Insel wurde. Am 15./16. Juli 1572 kamen Repräsentanten der meisten Städte der Niederlande in Dordrecht, im Gebäude „Het Hof“, zusammen. Dort machten sie Wilhelm von Oranien zu ihrem Führer und erklärten ihre Unabhängigkeit von Spanien.

Unabhängig und gleichzeitig europäisch zu sein, dies ist auch eine Grundfeste des DCA. Gegründet 1994 in Düsseldorf als „Verband Güteschutz Horizontalbohrungen e.V.“ oder außerhalb Deutschlands besser bekannt als „Drilling Contractors Association“, im frankophonen Raum betitelt als „Association des Entrepreneurs de Forage Dirigé“, versteht sich der DCA als unabhängiger europäischer Verband, der die Interessen seiner Mitglieder über alle Ländergrenzen hinaus vertritt. Der Verband ist weder rein deutsch, noch niederländisch, noch französisch, er ist europäisch. Die Förderung und Weiterbildung der HDD-Technik als Solche steht bei allem Handeln und Tun immer im Vordergrund!

Das stetige Feilen an den Inhalten der Technischen Richtlinien in drei Sprachen, die Durchführung von Fachtagungen an jährlich wechselnden Orten in Deutschland, den Niederlanden, in Belgien, in Frankreich, in Großbritannien und vielleicht 2019 in einem weiteren europäischen Land, der stetige internationale Austausch in Fachgremien, Arbeitskreisen und zum Thema Aus- und Weiterbildung, dies sind nur einige Punkte, die den Verband als länderübergreifenden interaktiven europäischen Verband kennzeichnen. Und dennoch muss an dieser Stelle immer wieder für eine gemeinsame Arbeit und Mitarbeit geworben werden. Der Vorstand lädt Sie herzlich ein, sich einzubringen und aktiv

an der Umsetzung der Zielsetzungen mitzuarbeiten.

Der gewählte Tagungsort Dordrecht liegt, wie die vorangegangenen Tagungsorte Marseille und Hamburg, an einem Knotenpunkt Europas und schafft Verbindungen zwischen Menschen aus anderen Ländern. Nutzen wir die Gelegenheit und knüpfen in den nächsten Tagen hier in Dordrecht neue Verbindungen und schaffen untereinander neue Anknüpfungspunkte im Sinne unserer HDD-Technik.

Kommen wir nun zur Veranstaltung zurück und blicken wieder auf das vorliegende Programm der nächsten beiden Tage.

Herzlich begrüßen möchte ich an dieser Stelle alle Vortragenden des diesjährigen Kongresses, stellvertretend hierzu begrüße ich zunächst Herrn Ir. H. J. Brink von der N.V. Nederlandse Gasunie. Herr Brink wird den Kongress mit dem Vortrag zum Thema „Gesteuerte Horizontalbohrtechnik Planung und Ausführung in der Retrospektive: 1980 – bis heute“ eröffnen. Herzlich Willkommen!

Gleich im Anschluss wird Herr Willem Smelik von der Firma Meewind einen Vortrag zum Thema “Entwicklung der Offshore-Windenergie Industrie“ halten. Herr Smelik, ebenfalls herzlich Willkommen in Dordrecht!

Herzlich begrüßen möchte ich weiterhin auch alle Mitglieder des DCA, wie in jedem Jahr ganz besonders natürlich unsere neuen Mitglieder. Herzlich Willkommen im Kreise der DCA-Familie!

In diesem Zusammenhang ebenfalls sehr herzlich begrüßen möchte ich den neuen Präsidenten des Rohrleitungsbauverbandes Herrn Fritz Eckard Lang von unserem langjährigen Mitglied der Fa. Bohrservice Rhein-Main Gesellschaft für Horizontalbohrungen mbH aus Bodenheim. Herr Lang herzlich willkommen!

Weiterhin möchte ich auch alle Gäste begrüßen, die die Tagung in Dordrecht zum Anlass genommen haben, sich hier über Neuerungen in der HDD-Technik zu informieren und die Möglichkeit nutzen wollen, neue Kontakte in der Industrie zu knüpfen. Auch Sie möchte ich herzlich willkommen heißen!

Nach den zwei genannten Vorträgen wird Herr Alexandre Cambier von HDI über „HDD link für 60 Millionen Nutzer“ referieren. Im Anschluss daran wird unser Vizepräsident Herr Jorn Stoelinga von Visser & Smit Hanab bv in seinem Vortrag uns über das Thema „Oh my god“ informieren und in diesem Zuge einen Vorgeschmack auf die am Nachmittag stattfindende Podiumsdiskussion zum Thema „Trouble Shooting“ geben. Nach der Mittagspause können Sie sich auf die vorgenannte Podiumsdiskussion unter der Leitung von Herrn Kissing von der Firma Open Grid Europe freuen.

Am morgigen Freitag finden wie gewohnt Vorträge zu aktuellen HDD-Projekten und zu weiteren Themen im Umfeld der Branche statt. Neben einem Vortrag von Herrn Billig und Herrn Rowney über „Alles was man über Wireline Steuerungssysteme bei HDD wissen möchte, aber sich nie getraut hat zu

fragen“, referiert Herr Huffman über „Alles was man über Bohrrohre bei HDD wissen möchte, aber sich nie getraut hat zu fragen“. Dazwischen gibt es Informationen zum „Risikomanagement bei HDD-Projekten“ von Herrn Mullins sowie zum Thema „Kreuzung des Danube Flusses“, im Teil 1 Geotechnik von Herrn Donié, im Teil 2 HDD Ausführung von Herrn Kruse.

Zum Abschluss meiner kurzen Einführung wünsche ich Ihnen und uns nun interessante und fachlich hochkarätige Vorträge, offene und kritische Diskussionen und einen insgesamt erlebnisreichen Aufenthalt im schönen Dordrecht.

Ihr

Dipl.-Geol. Dietmar Quante
DCA - Geschäftsführung

Welcoming

Dear Ladies and Gentlemen,

It is a great pleasure and honour for me to welcome you for the first time in my function as president of the DCA to our association's annual congress here in Dordrecht. We are hoping that we will be able to offer you on the one hand an interesting programme peppered with many valuable information, and on the other hand a diversified and entertaining social programme.

I particularly welcome our former president Hermann Lübbers. Hopefully you can enjoy this congress stress-free for once from the other side.

Last year we visited the port metropolis Hamburg in Northern Germany; this year we are back again in the Netherlands, home of many DCA members. Our executive secretary Dietmar Quante has already presented Dordrecht's peculiarities and the programme in detail.

Our special thanks go to the sponsors of this year's congress. The financial contributions of these companies added a great deal that this congress will be a success:

- Baroid IDP
- Brownline b.v.
- Deltares
- Egeplast International GmbH
- Gebr. van Leeuwen Boringen B.V.
- Normag
- N.V. Nederlands Gasunie
- Vermeer
- Visser & Smit Hanab b.v.

Apart from these sponsors, I wish to express my thanks to our vice-president Jorn Stoelinga and his colleagues of Visser & Smit Hanab b.v. They actively and tirelessly helped looking into details of the social programme and the venue. Furthermore Jorn also won over most of the sponsors of this congress I mentioned. Thanks a lot for that!

My dear ladies and gentlemen, the DCA steamship indeed changed its captain this year but this happened in full steam more or less - and the course was maintained. The fact that the former captain is on board as passenger now I record as sign of confidence in the present crew.

Many tasks that have been tackled in the past year are continued by us. Among those are for example the task groups, and first of all the task group “disposal of drilling fluids and drill cuttings”. I understand that some of you impatiently wait for a conclusion or result of this task group. And I know that there are some approaches meanwhile how to deal with this matter on company or regional levels; surely these are justified and advantageous. But DCA’s board does not want to present a multitude of isolated applications. We wish to develop minimum standards or reliable guidelines for all HDD measures that

- cover all legal requirements,
- are feasible and calculable,
- do not jeopardise the economic efficiency of the HDD method,
- recommend contractual responsibilities,
- offer fair competitive conditions,
- leave room for optimisation specific to a project (like alternative bids),
- are internationally applicable or conferrable.

This requires numerous talks and discussions - among the DCA member companies, within the field of HDD, but also beyond with ministries, representatives of clients etc. Please allow for some extra time that the task group and we can completely cope with the aforementioned requirements. We will surely be some steps further at our members’ meeting in February.

The second task group is dealing with the matter “coating quality”. Here, too, a lot of work has been invested already; but likewise it has to be continued for a while. Around the world reams of coating materials and system combinations are in use. The task group members have been catching up on the most established forms and now are evaluating these in terms of application. And again, the members of this task group had to become acquainted with topics outside of their subject areas, like chemical, physical or electro-technical processes to be able to understand and evaluate the correlations. Meanwhile the findings are being interpreted and recorded; results can soon be expected as well.

Let us return to this congress; “HDD first“ is our motto this year. Friendly inspired by Mr. Trump...
One of the central points of this event will be the panel discussion “HDD Trouble Shooting”.
Not just the two task groups I have delineated are a reaction to the enhanced requirements directed to the field of HDD. Other claims are for example raised in view of

- the accuracy of pilot drillings,
- coping with difficult soils and obstacles,
- the forecast of potential risks and difficulties,
- observance of the workflow, the precalculated drilling parameters, etc.

that often max out what is feasible at the moment (or even go beyond). The HDD method has already been far developed. In the beginnings surely often the trial and error method was applied. But thankfully we left this behind in the meantime. On the other hand we cannot call the HDD method an industrialised production process yet.

We, DCA's regular members, are also competing, both with conventional pipe laying and with other trenchless construction methods. Often those still have a lead in terms of precision and reliability. We have to try to reduce this lead, namely by learning from experiences and errors, ideally not only from ours but from those of the whole field of industry.

DCA's last Newsletter already informed you that the board set the goal to build up a kind of "failure management" within its membership. Failure does not necessarily mean lack of performance, however; rather we understand it as deviation from the original plan. False estimations and misinterpretations (for example in geology) are also relevant of course.

HDD contractors in the DCA are reasonably aware what unplanned and unwanted incidents can impede the works or cause additional efforts in practice. Loss of drilling fluids, blowouts, breaking bars, tool wear - these are just some items on the long list of problems that have to be solved. If it is anyhow possible we prefer to shut these experiences away in our company. Or we well treasure these experiences and estimate them as a future advantage in competition. But instead we should increasingly and associated avail ourselves of just these experiences; in order to effectively augment the quality and reliability of the HDD method in its entirety.

"You can avoid mistakes if you gain experiences.
And you gain experiences if you make mistakes"
(Laurence Johnston Peter (1919-1990), American management consultant)

Therefore we decided to start right away this afternoon. During a panel discussion, the drilling contractors represented in DCA's board will for once not present highlights of their projects. We are all aware or are regularly informed what first-class performances can be achieved by the HDD method. But now we want to focus on the basis. What can we do to make day-to-day drilling measures more reliable, more precise and more foreseeable - keyword "reproducibility" of a performance of high quality. Issue of the discussion therefore will be the incidents we all know but definitely no-one wants to experience.

Jorn Stoelinga will hold an introducing lecture before lunch break.

Its title: "Oh my God"

The ensuing panel discussion will be based on five selected topics that will be presented in form of short lectures by members of the board. They will come from the field of large-scale drilling as well as from the area of smaller and medium facilities.

I appeal to all of you, please take an active part in the discussions this afternoon. Assist all of us by exchanging your experiences so that we can further optimise the HDD method. We want to be able to keep saying swollen with pride: "HDD is first".

Last but not least I wish to cordially thank all lecturers for supporting our congress with their lectures today and tomorrow. You are the backbone of this event.

And already now I would like to stimulate you, ladies and gentlemen, offer or suggest us some interesting topics for the next congress.

All that remains is for me to declare this 22nd DCA congress open. I wish us all lots of information, interesting conversations and a pleasant time here in Dordrecht.

Thank you very much.

Marc Schnau
DCA-President

Begrüßung

Sehr geehrte Damen und Herren,

es ist mir eine ganz besondere Ehre, Sie zum ersten Mal als Präsident des DCA zur Jahrestagung des Verbandes hier in Dordrecht begrüßen zu dürfen. Wir hoffen, dass wir Ihnen einerseits ein interessantes Programm mit vielen wertvollen fachlichen Informationen bieten können. Andererseits aber auch ein abwechslungsreiches und unterhaltsames Rahmenprogramm.

Besonders begrüßen möchte ich auch unseren ehemaligen Präsidenten Hermann Lübbers. Ich hoffe, Du kannst diese Tagung jetzt mal ganz entspannt von der anderen Seite aus genießen.

Nachdem wir im letzten Jahr die norddeutsche Hafenmetropole Hamburg besucht haben, sind wir jetzt wieder in den Niederlanden, wo zahlreiche DCA-Mitglieder ansässig sind. Über Dordrecht, die Besonderheiten dieser Stadt und das detaillierte Programm hat unser Geschäftsführer Dietmar Quante bereits berichtet.

Unser besonderer Dank gilt den diesjährigen Sponsoren der Veranstaltung. Ihren finanziellen Beitrag zum Gelingen haben folgende Firmen geleistet:

- Baroid IDP
- Brownline b.v.
- Deltares
- Egeplast International GmbH
- Gebr. van Leeuwen Boringen B.V.
- Normag
- N.V. Nederlands Gasunie
- Vermeer
- Visser & Smit Hanab b.v.

Neben den Sponsoren möchte ich ein weiteres Dankeschön aussprechen. Und zwar an unseren Vize-Präsidenten Jorn Stoelinga und seine Kollegen von Visser & Smit Hanab b.v. . Sie haben tatkräftig und unermüdlich dabei geholfen, das Rahmenprogramm und die Räumlichkeiten zu recherchieren und im Detail abzustimmen. Weiterhin hat Jorn auch die meisten der vorgenannten Sponsoren für diese Veranstaltung gewinnen können. Vielen Dank dafür!

Meine verehrten Damen und Herren, der DCA-Dampfer hat in diesem Jahr zwar den Kapitän gewechselt - das geschah aber mehr oder weniger bei voller Fahrt voraus und unter Beibehaltung des Kurses. Die Tatsache, dass der Ex-Kapitän wieder als Passagier an Bord ist, verbuche ich mal als einen kleinen Vertrauensbeweis an die jetzige Besatzung.

Viele Aufgaben, die im letzten Jahr begonnen wurden, haben wir weitergeführt. Dazu zählen zum Beispiel die Arbeitskreise und hier zunächst der Arbeitskreis „Entsorgung von Bohrspülung und Bohrklein“. Ich verstehe, dass einige sehr ungeduldig auf einen Abschluss bzw. auf ein Ergebnis dieses Arbeitskreises warten. Ich weiß auch, dass es inzwischen einige unternehmens- oder regionsspezifische Lösungsansätze zum Umgang mit diesem Thema gibt.

Diese haben mit Sicherheit Ihre Berechtigung und Vorzüge. Der Vorstand des DCA möchte aber nicht eine Vielzahl von möglichen Insellösungen präsentieren. Wir möchten einen Mindeststandard bzw. einen verlässlichen Leitfaden für alle HDD-Maßnahmen entwickeln, der

- die rechtlichen Anforderungen abdeckt,
- praktikabel und kalkulierbar ist,
- die Wirtschaftlichkeit des HDD-Verfahrens nicht gefährdet,
- vertragliche Zuständigkeiten empfiehlt,
- faire Wettbewerbsbedingungen bietet,
- Raum für projektspezifische Optimierungen lässt (z.B. über Nebenangebote),
- international anwendbar bzw. übertragbar ist.

Hierfür sind zahlreiche Gespräche und Diskussionen erforderlich, unter den DCA-Mitgliedsfirmen, innerhalb der HDD-Branche, aber auch außerhalb mit Ministerien, Auftraggebervertretern etc.. Bitte geben Sie uns und dem Arbeitskreis noch ein wenig Zeit, damit die o.g. Anforderungen auch in Gänze abgedeckt werden können. Zu unserer Mitgliederversammlung im Februar werden wir sicher einen Schritt weiter sein.

Der zweite Arbeitskreis beschäftigt sich mit dem Thema „Umhüllungsqualität“. Auch hier ist bislang schon viel Arbeit investiert worden. Diese muss aber auch noch etwas weiter fortgeführt werden. Es sind international unzählige Umhüllungsmaterialien und Systemkombinationen im Einsatz. Der Arbeitskreis hat sich umfassend über die gängigsten Formen informiert und ist dabei, diese für den Einsatz zu bewerten. Auch in diesem Arbeitskreis musste man sich mit fachfremden Themen, wie chemischen, physikalischen und elektrotechnischen Prozessen befassen, um die Zusammenhänge verstehen und bewerten zu können. Inzwischen werden diese ausgewertet und niedergeschrieben. Auch hier werden wir in Kürze Ergebnisse erwarten können.

Nun zurück zum Kongress „HDD First“ – Unser diesjähriger Tagungstitel. Mit freundlicher Inspiration durch Herrn Trump…

Einer der Kernpunkte dieser Veranstaltung ist die Podiumsdiskussion „HDD-Trouble-Shooting“. Nicht nur die beiden vorhin beschriebenen Arbeitskreise sind eine Reaktion auf gestiegene Anforderungen an die HDD-Branche. Auch weitere Ansprüche z.B. an

- die Genauigkeit der Pilotbohrungen,
- die Bewältigung schwieriger Böden und Hindernisse,
- die Vorhersage potentieller Risiken und Erschwernisse,
- die Einhaltung des Ablaufplanes, der vorausberechneten Bohrparameter, etc.

sind oftmals an der Grenze des derzeit Machbaren (oder bereits darüber hinaus). Das HDD-Verfahren hat sich schon weit entwickelt. In den Anfängen wurde sicherlich oftmals auch die „Versuch und Irrtum“ – Methode praktiziert. Davon sind wir inzwischen, zum Glück, schon weit entfernt. Als industrialisierten Produktionsprozess können wir das HDD-Verfahren aber auch noch nicht bezeichnen.

Wir, die aktiven DCA-Mitglieder, stehen alle auch gemeinsam im Wettbewerb sowohl mit der konventionellen Rohrverlegung sowie auch mit anderen grabenlosen Bauverfahren. In puncto Genauigkeit und Verlässlichkeit haben diese oftmals noch einen Vorsprung. Diesen müssen wir versuchen zu verkleinern. Und zwar dadurch, dass wir aus Erfahrungen und Fehlern lernen. Und idealerweise nicht nur aus eigenen, sondern aus denen der Branche.

Wie bereits im letzten DCA Newsletter informiert, hat sich der Vorstand zum Ziel gesetzt, eine Art „Fehlerkultur“ innerhalb der Mitgliederschaft aufzubauen. Fehler sind dabei nicht zwangsläufig als Mangel in der Leistungsausführung anzusehen, sondern vielmehr als Abweichung vom ursprünglichen Plan zu verstehen. Dabei spielen naturgemäß Fehleinschätzungen/Fehlinterpretationen (z.B. der Geologie) auch eine Rolle. Den HDD Bohrunternehmen im DCA ist leidlich bekannt, was in der Praxis während der Bohrausführung an ungeplanten und unerwünschten Vorkommnissen die Arbeiten erschweren bzw. für zusätzlichen Aufwand sorgen kann. Spülungsverluste, Ausbläser, Gestängebrüche, Werkzeugverschleiß,… sind nur einige Punkte aus der Vielzahl an Problemstellungen, die es zu lösen gilt. Wenn irgendwie möglich, werden diese Erfahrungen gerne in den Firmen unter Verschluss gehalten. Oder die erlangten Erfahrungen werden als zukünftiger Wettbewerbsvorteil angesehen und daher gut gehütet. Gerade diese Erfahrungen sollten im Verband vermehrt gemeinsam zunutze gemacht werden, um die Qualität und die Verlässlichkeit des HDD-Verfahrens in Gänze nachhaltig zu steigern.

„Fehler vermeidet man, indem man Erfahrungen sammelt.
Erfahrungen sammelt man, indem man Fehler macht“
(Laurence Johnston Peter (1919-1990), amerikanischer Managementberater).

Deshalb haben wir uns entschlossen, heute Nachmittag damit zu beginnen. Die im DCA-Vorstand vertretenen Bohrunternehmen werden im Rahmen der Podiumsdiskussion diesmal gerade nicht die Highlights ihrer Projekte vorstellen. Wir wissen alle bzw. werden laufend informiert, zu welchen Spitzenleistungen das HDD-Verfahren fähig ist. Wir wollen aber nun einen Fokus auf die Basis richten. Was können wir tun, um die alltäglichen Bohrmaßnahmen ausführungssicherer, genauer und vorher-

sehbarer zu machen – Stichwort „Reproduzierbarkeit“ qualitativ hochwertiger Leistung. Thema der Diskussion sind daher diesmal die Vorkommnisse, die wir alle kennen, aber die definitiv keiner haben möchte.

Jorn Stoelinga wird zum Einstieg vor der Mittagspause einen Einleitungsvortrag halten.

Titel: „Oh my God“

Die anschließende Podiumsdiskussion basiert auf insgesamt fünf ausgesuchten Themenkomplexen, die von Mitgliedern des Vorstandes in Kurzvorträgen vorgestellt werden. Hierbei kommen sowohl Themen aus der Großbohrtechnik als auch aus dem Bereich der kleineren und mittleren Anlagen zur Diskussion.

Ich möchte Sie alle aufrufen sich heute Nachmittag aktiv an den Diskussionen zu beteiligen. Helfen Sie mit, durch Teilung Ihrer Erfahrungen dazu beizutragen, das HDD-Verfahren weiter zu optimieren. Damit wir weiterhin mit stolzer Brust feststellen und behaupten können: „HDD **is** First“.
Last but not least möchte ich mich bei allen weiteren Referenten, die unseren Kongress durch ihre Vorträge heute und morgen unterstützen, recht herzlich bedanken. Sie sind eine tragende Säule dieser Veranstaltung.

Und Sie, meine Damen und Herren, möchte ich bereits jetzt motivieren, für die nächste Tagung interessante Vortragsthemen anzubieten oder vorzuschlagen.

Jetzt bleibt mir nur noch, diese 22. DCA Jahrestagung für eröffnet zu erklären. Ich wünsche uns allen einen informativen Kongress, interessante Gespräche und eine schöne Zeit hier in Dordrecht.

Ihr

Marc Schnau
DCA-Präsident

Horizontal Directional Drilling -Design and construction over the years: 1980 - present

The technique of horizontal drilling is applied at Gasunie since the early 80's.
The first drilling of a natural gas pipeline was the executed under the “Buiten IJ” near Amsterdam. This drilling was carried out in 1984.
Due to the construction of the IJ-tunnel for the highway A10 around Amsterdam an existing sinker had to be moved. This existing sinker was exactly in the place where the Zeeburgertunnel was planned. During the preparations for the relocation, Hak proposed to apply the horizontal directional drilling technique. This technology, developed in America, has been widely applied abroad, but for the Netherlands, however, this was something new. Gasunie saw the benefits and agreed upon the contractor's proposal.

The advantages given over the conventional technique were:

- Faster execution (3wk vs 4mnd)
- Cheaper
- No need to dig open the dikes
- Environmentally friendly (low excavation volume, drilling with natural product)
- No need to dredge
- No obstruction to shipping
- Houseboats can in place.

Before this HDD drilling could be carried out, various licensing authorities like the water board and the Rijkswaterstaat had to be convinced of the feasibility. The implementation was allowed as an experiment.

This first drilling involved a regional transport line with a diameter of 16 inches. The drilling had a length of 600 m. The pipe string was layed down in two parts. These two parts were welded together during pull in.

The following two HDD drills were performed in the province of Zuid-Holland, where the licensing authorities had to be convinced of the new technology. Under the conditions that the technology would first be conducted as a trial and that a workgroup would be formed which would draft rules for the application of this technique in the future, the execution of these drills was allowed. In particular, the “Provincial Waterstaat” of Zuid-Holland stated that there would be a good foundation for all the design and implementation aspects of interest.

These two drills, a drilling under the river Rotte and under the Ringvaart of the Zuidplaspolder have been carefully monitored. After the successful completion of these drillings, the working group quickly came up with positive advice and draft rules. for the following:

- Pull force calculation
- Mud pressure calculation
- Strength calculation of the pipe

The HDD methodology was included in the 1990 edition of the Pipeline Code of Zuid-Holland.

Although the first drillings have been successful, there were several problems that had to be solved during the work. It turned out that the location system was sensitive to disturbances. The bore under the “Buiten IJ” was so far aside the planned drill line that the pilot was pulled back and that part of the route had to be redrilled. Eventually, the pilot reached the exit point 3 m next to the intended point. Furthermore, there were quite a lot of mud exposures.

Things that could be improved were:

- Measurement system; disturbances of the earth magnetic field cause excessive deviations;
- Control measurements of the final position still had to be developed;
- Control of the borehole mud pressure;
- Use toxic additive to the drilling fluid;

Research programs were also set up to improve HDD technology, such as the BTL research project.

Since the first drilling under the “Buiten IJ” in Amsterdam, many drills have been carried out. Over the years, the percentage of new traces carried out through HDD drillings increased steadily. The high point was the pipeline route from Beverwijk to Wijngaarden. A third part of this route was made using the HDD technique.

Occasionally, however, incidents happened during the performance of a drilling and the damage had to be paid by the insurance company. As a consequence, the insurer was increasingly involved in the execution. Requirements were made for the following matters:

- Location
- Mud pressure calculations
- Coating
- Bending radius of the drill line
- Ballasting to lower the tensile forces
- Equipment

The factory coating with which the first drillings were made was PE, after a number of coating damage, it was attempted to protect the PE by applying a GVK layer over this. Sometimes this was successful other times not. After solving problems with application of the field weld coating (flame spray and PUPP lining), Gasunie has completely switched to PP.

Over time, there was a need for unambiguous regulations by Gasunie, which laid down the requirements for drillings, so that all contractors could make an offer based on the same assumptions. This resulted in a Gasunie Technical Standard CSW-56-N “Requirements for Drillings”.

The common approach of project execution is the conventional way of working in which Gasunie performs the preparation and prepares the design. After that, the contract will be tendered and the contractor will execute the drillings as part of the construction.
The latest development concerns this procedure. Gasunie introduced the VIA method. VIA stands for Forward Integration Contractors. This implies that contractors are early involved in the project and become accountability for the detail design. Gasunie retreats has less concern with the construction fase of the project and mainly tries to controls the project on a risk based way. In this new procedure, the importance of good risk analyzes becomes greater. Contractors will be asked to develop more comprehensive and better risk analyzes and provide them with the detail design. In this way, the contractor can demonstrate that he has the construction in hand and, in case of deviations, takes action in time.

Ir. H.J. Brink – N.V. Nederlandse Gasunie

Horizontal Directional Drilling
Design and construction over the years: 1980 - present

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- The first HDD in the Netherlands
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- First HDD of a 36” HTL pipeline
- HDD’s North-South projects
- Pipeline code and NEN 3650
- Problems and improvements

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- Coating
- Gasunie technical standard
- New methods
- System-oriented contract management

The Netherlands: 50 years gasland

Slochterenfield (1959):

ca. 2.800 miljard m³ and furthter more hundreds small gasfields

Aardgas

- Production : NAM
- Sale : GasTerra
- Transport : Gasunie

gasunie crossing borders in energy

July 2005: Gasunie demerged

One company ⟵ 1 July 2005 ⟶ Two companies

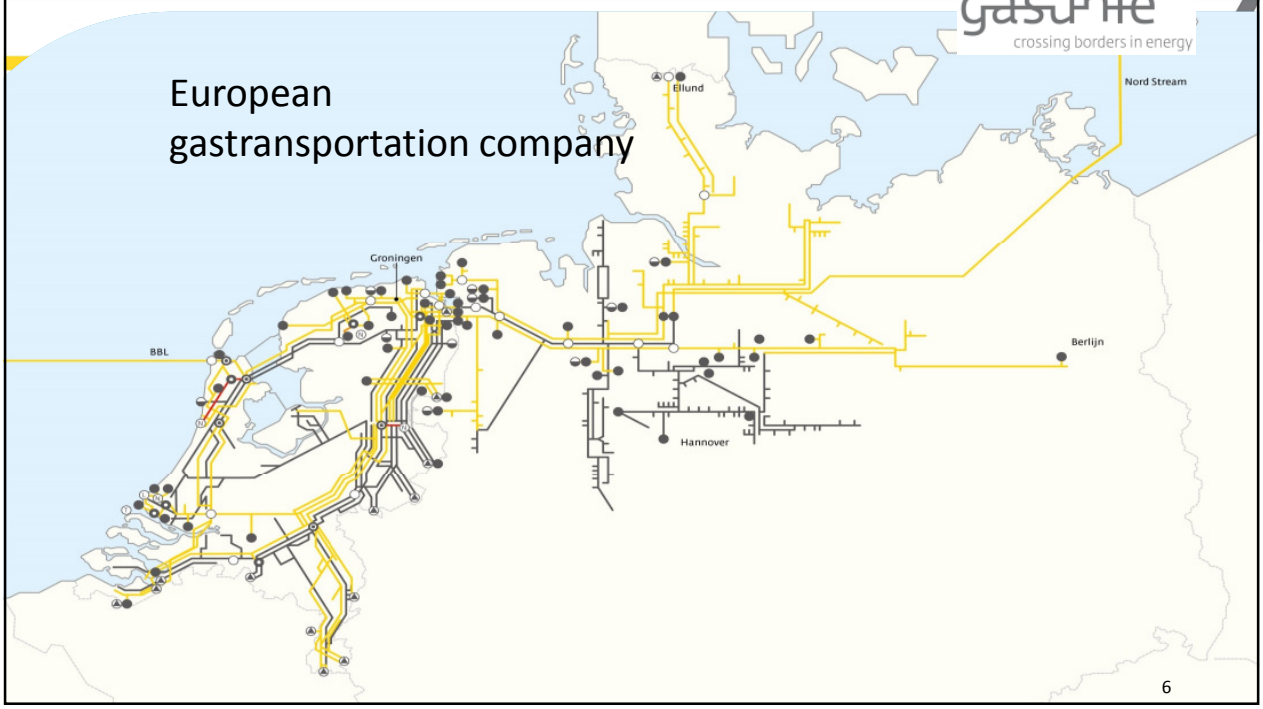
Gasunie
Esso 25%
Shell 25%
50%

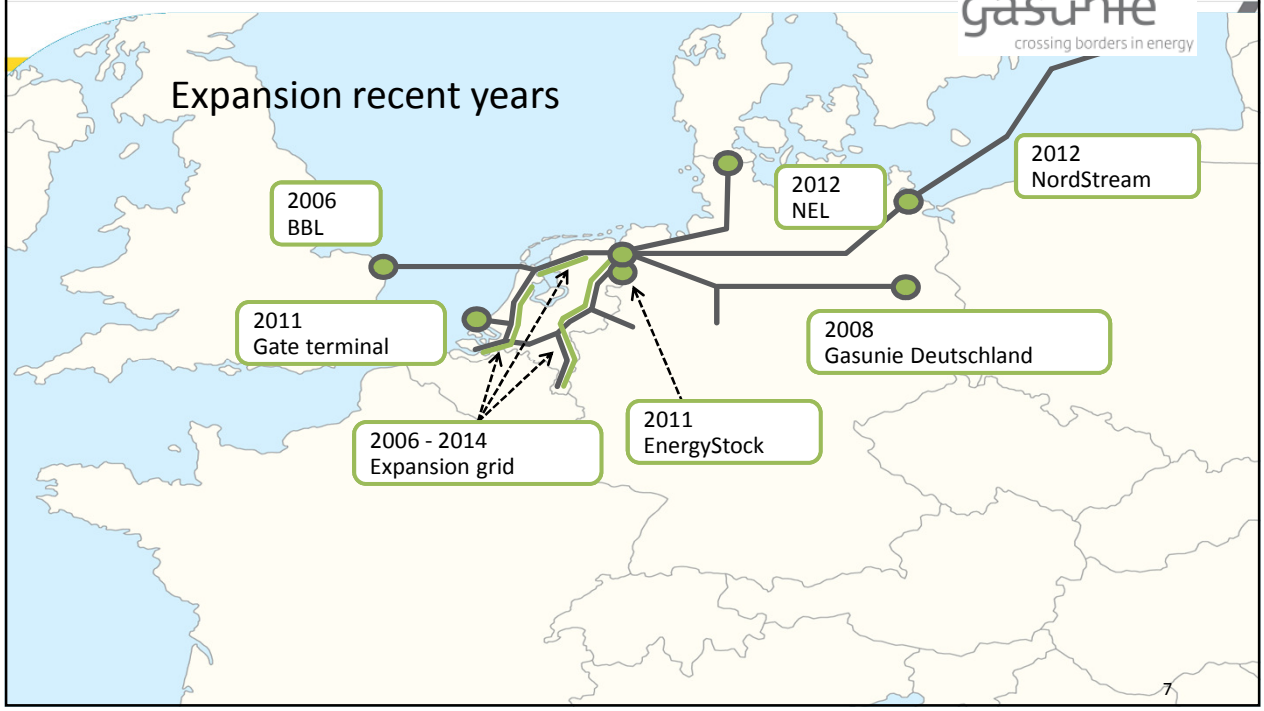
gasunie
Infrastructure and transport
100%

GasTerra
Trading
Esso 25%
Shell 25%
50%

gasunie crossing borders in energy

European gastransportation company





The "Buiten IJ"

The "Buiten IJ"

- Advantages over the conventional technique were:
  - Faster execution (3wk vs 4mnd)
  - Cheaper
  - No need to dig open the dikes
  - Environmentally friendly (low excavation volume, drilling with natural product)
  - No need to dredge
  - No obstruction to shipping
  - Houseboats can stay in place.

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The "Buiten IJ"

- Drilling:
  - DN 400 , 16.7 mm,
  - RTL, design pressure: 40 bar(g)
  - Length: 600 m
  - Depth: 6 m below the bottom of the Buiten IJ

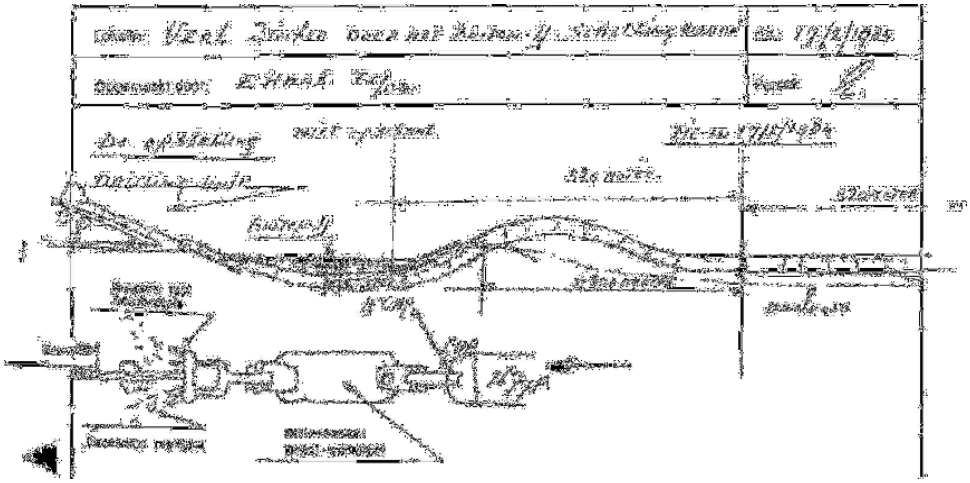
The “Buiten IJ”

The “Buiten IJ”

gasunie
crossing borders in energy

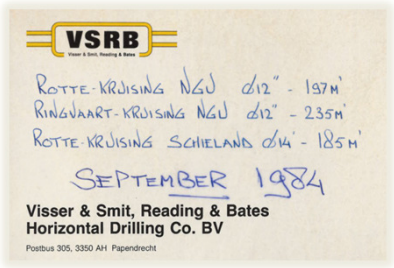
The “Buiten IJ”

- Construction



The first HDD in the Netherlands

Drillings under the Rotte and the Ringvaart



The Rotte

The Rotte

Drilling under the Ringvaart

The Ringvaart of the Zuidplaspolder

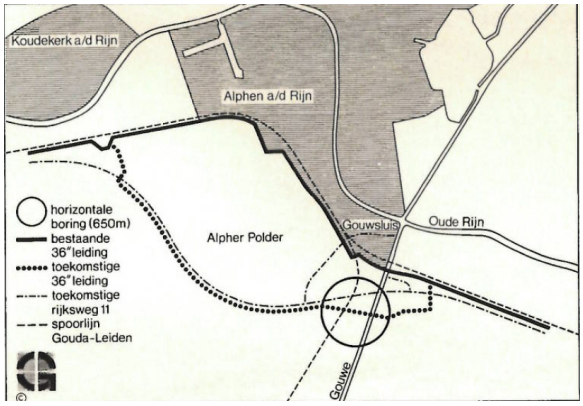
The Ringvaart of the Zuidplaspolder

The Ringvaart of the Zuidplaspolder

The Ringvaart of the Zuidplaspolder

First HTL - Alphen aan den Rijn

- 1985



Alphen aan den Rijn

- A-515
- HTL
- 36”

HDD's North-South projects

HDD´s North-South projects

Line no.	Pipeline name	Length route [km]	No. HDD´s	Length HDD´s [m]	Percentage
A-655	Hattem - Flevocentrale	49,0	11	6913	14,1
A-660	Rysum - Scheemda	24,5	0	0	0,0
A-661	Scheemda - Ommen	92,0	5	2875	3,1
A-662	Ommen - Angerlo	68,0	9	7060	10,4
A-663	Angerlo-Beuningen	37,0	9	6140	16,6
A-666	Scheemda - Tripscompagnie	15,5	1	560	3,6
A-667	Westerschelde West - Cambron	31,0	1	984	3,2
A-667	Wijngaarden - Westerschelde West	86,0	16	13919	16,2
A-677	Oude Statenzijl - Scheemda	16,0	1	652	4,1
A-803	Beverwijk - Wijngaarden	90,0	32	32500	36,1

Pipeline code and NEN 3650

gasunie crossing borders in energy

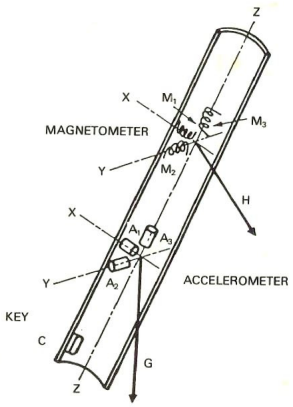
- Provinciale Waterstaat Zuid Holland
- NEN

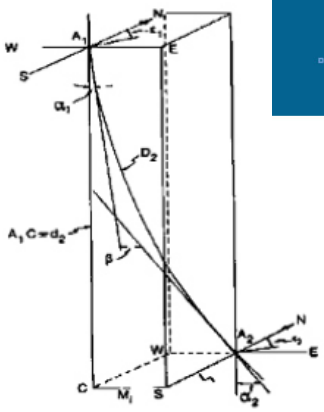
Problems and improvements

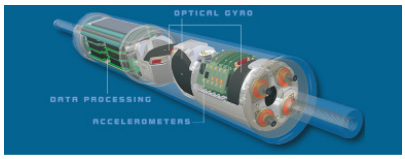
- Accuracy drill line
- Mud blow outs
- Coating damage
- Too high pull forces
- Obstacles
- Gravel
- Broken drill rods

Problems and improvements

- Accuracy drill line

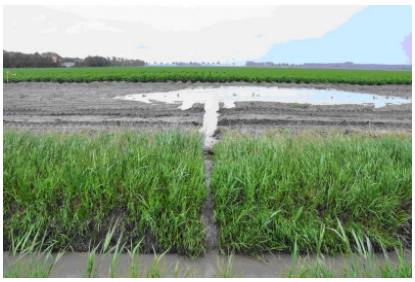






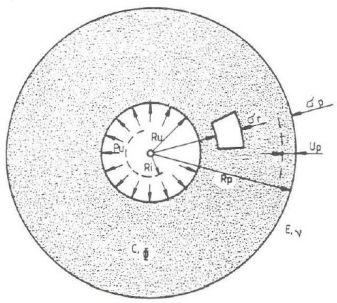
Problems and improvements

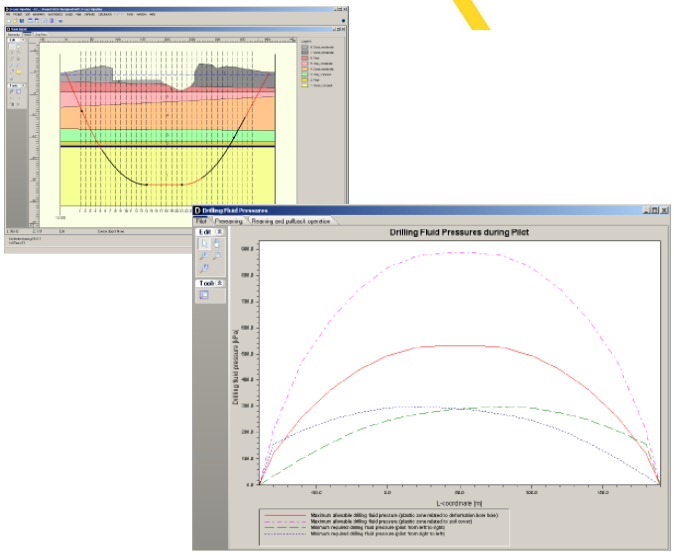
- Mud blow outs / settlements



Problems and improvements

- Mud blow outs





Problems and improvements

- Too high pull forces
  - Buoyancy control
    ± 250 kg/m netto weight

Problems and improvements

- Coating damages
  Mainly damage of the field weld coating

Measures:

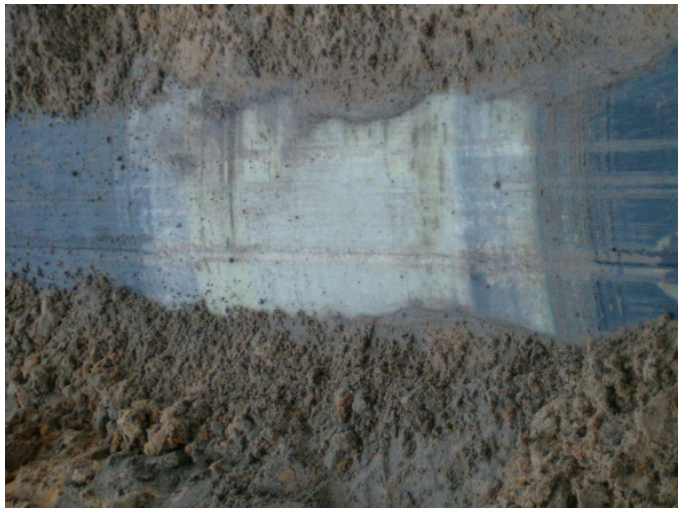
- More attention to the application
- Take sufficient time
- Well connection with factory coating
- Balancing pipe during pull back

Coating

- PE

Coating

- PE



Coating

- PE + fibre rock

Coating

- PP + Flamespray

Coating

- PP + PUPP lining

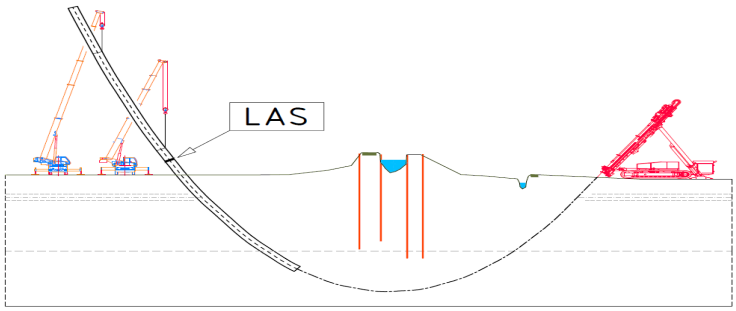
Gasunie technical standard

- Specification:
  Gasunie Technical Standard CSW-56-N
  ¨Execution requirements for drillings¨

- Focus on:
  - Method description
  - Calculations
  - Registration
  - Prevention and mitigation of execution risks

New methods

- Arch drilling / bow boring



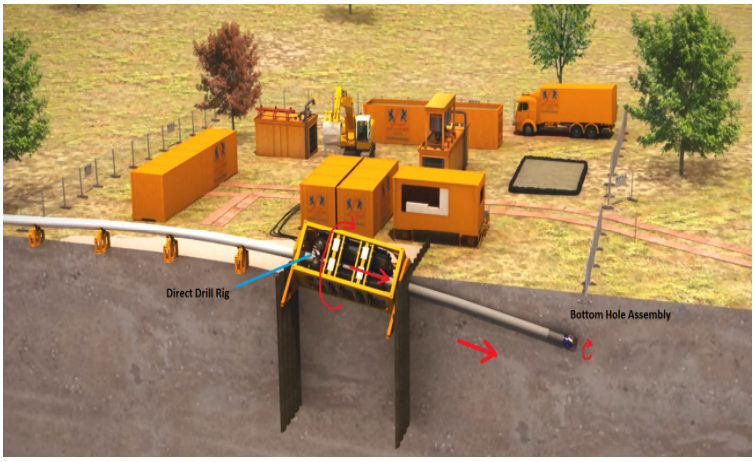
New methods

- Arch drilling / bow boring

New methods

gasunie crossing borders in energy

- Direct Drill



New methods

gasunie crossing borders in energy

- Direct Drill

System-oriented contract management

- Traditional contract
  - Client (Gasunie) is responsible for:
    - Initiative
    - Project definition
    - Concept design
    - Investigations
    - Detail design
    - Specifications
    - Scope of work

System-oriented contract management

- Traditional contract
  - Contractor is responsible for:
    - Construction and drilling process
    - Delivery as-built

System-oriented contract management

- New contract
  - Client (Gasunie) is responsible for:
    - Initiative
    - Project definition
    - Concept design

System-oriented contract management

- New contract
  - Contractor is responsible for:
    - Investigations
    - Detail design
    - Specifications
    - Scope of work
    - Construction and drilling process
    - Delivery as-built

System-oriented contract management

- Minimal interference with contractor
- Focus on quality management of the contractor

System-oriented contract management

- Risk based
  - Process
  - Risks
  - Noticing deviations
  - Taking measures
  - Evaluate

System-oriented contract management

- Requirements:
  - Quality management,
  - Processes and
  - Products
- Check compliance to requirements by client

System-oriented contract management

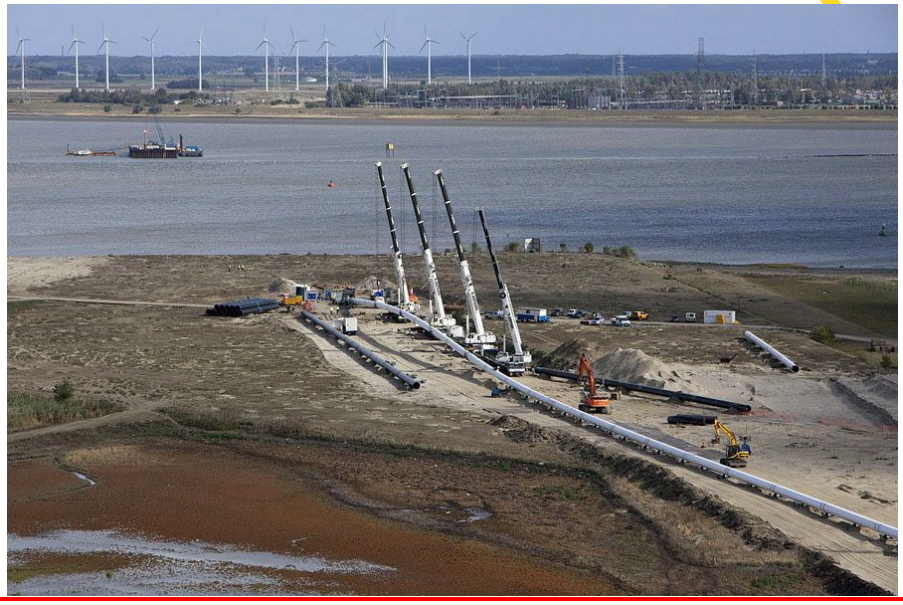
- But after all a good design is a necessary condition for a succesfull HDD.
- Basic design and detail design must complement.
- Challenge:
  - Performing good technical risk analysis
  - Enough but not to much measures to control the execution

River Alblas

Polderbaan

River Waal

The Westerschelde



The future of offshore wind in Europe

Willem Smelik – Managing Director

Meewind

October 2017

meewind

3 Belgian offshore wind farms

- Belwind – 2010
- Northwind – 2014
- Nobelwind – 2017

Belwind

- 165 MW
  - 55 x 3MW Vestas V90
- 2010
- Parkwind
- Meewind

Northwind

- 216 MW
  - 72 x 3MW Vestas V112
- 2014
- Parkwind
- Sumitomo
- Aspiravi
- Meewind

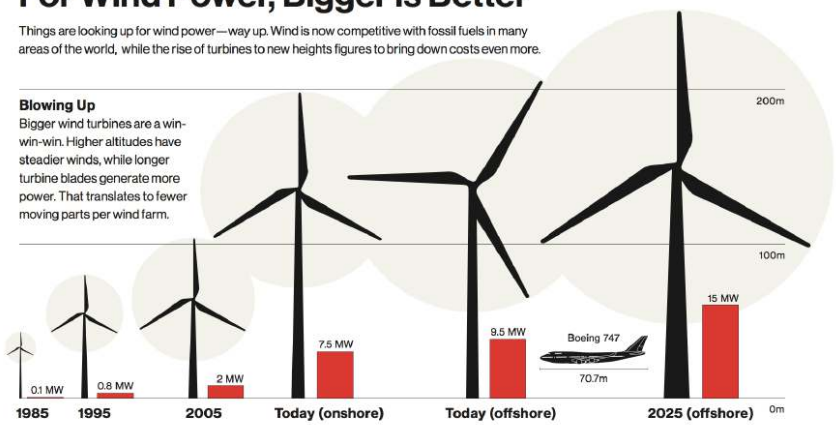
Nobelwind

- 165 MW
  - 50 x 3,3MW Vestas V112
- 2017
- Parkwind
- Sumitomo
- Meewind

For Wind Power, Bigger Is Better

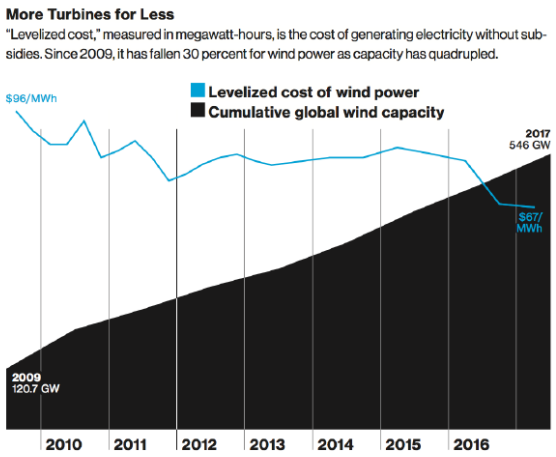
Things are looking up for wind power—way up. Wind is now competitive with fossil fuels in many areas of the world, while the rise of turbines to new heights figures to bring down costs even more.

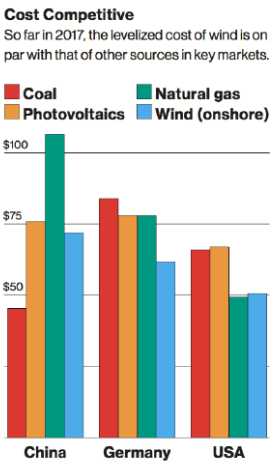
Blowing Up
Bigger wind turbines are a win-win-win. Higher altitudes have steadier winds, while longer turbine blades generate more power. That translates to fewer moving parts per wind farm.



For offshore wind power size does matter

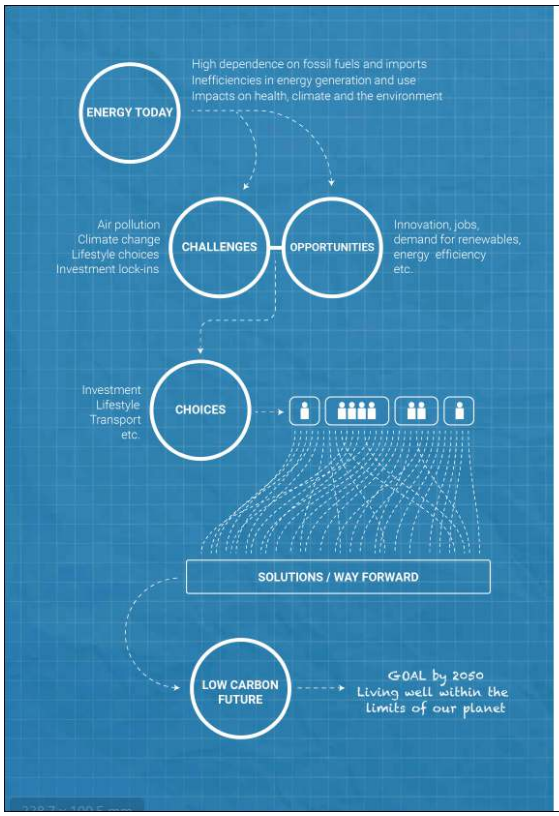
Bigger turbines are higher and reduce the amount of moving parts with equal power output.





Price does matter as well

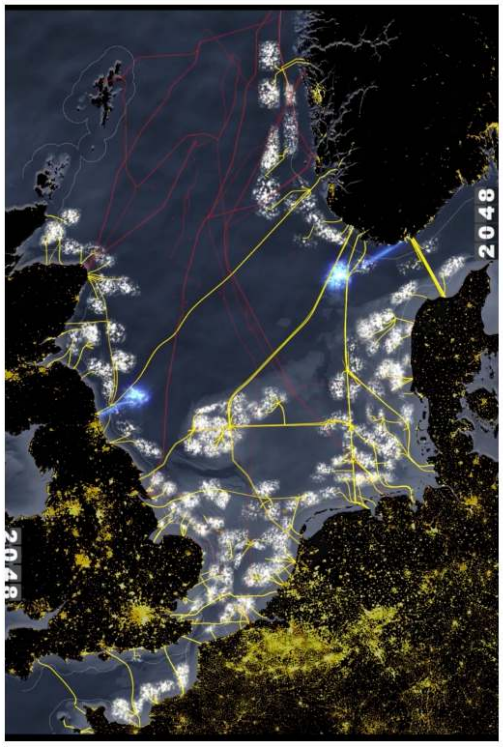
In most parts of the world the LCOE of wind is on par with other sources

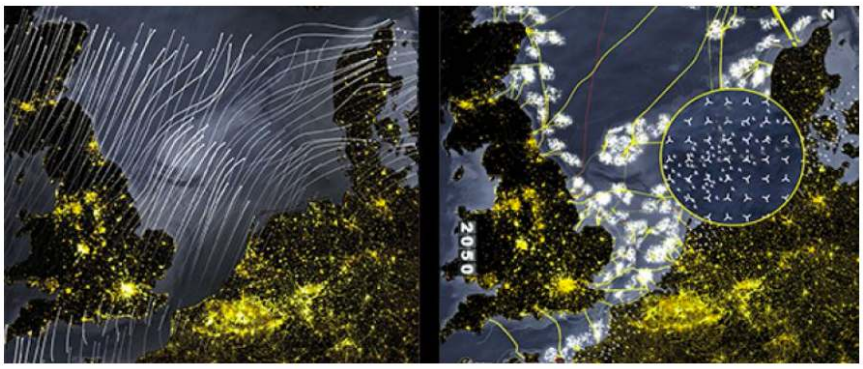


So how do we see the future

A few things to take into consideration:

- Paris Climate Agreement 2015
- Densely populated land
- Both a National and a Continental challenge
- Northsea is perfectly located for large scale offshore wind farms



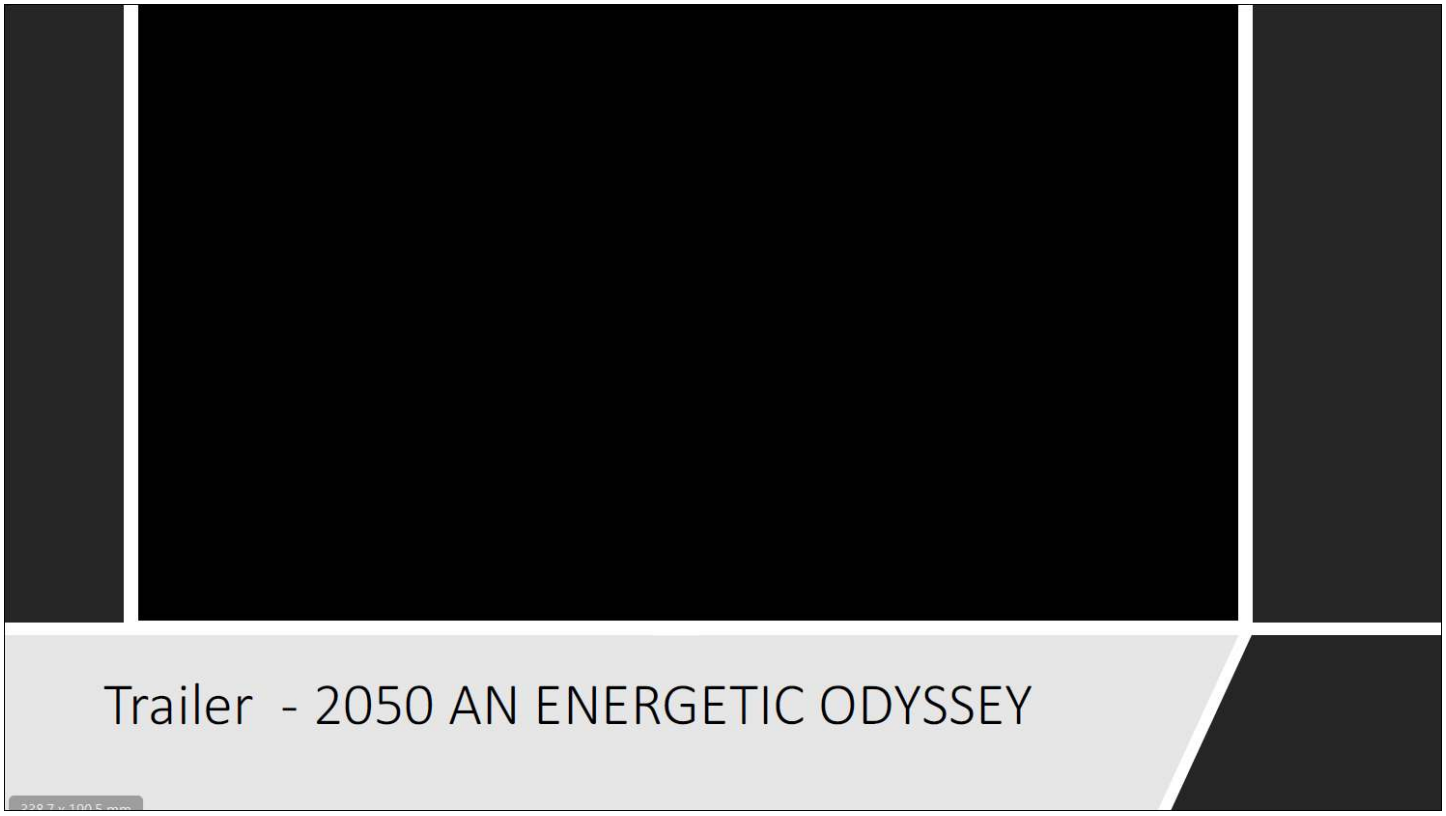


2050 – AN ENERGETIC ODYSSEY

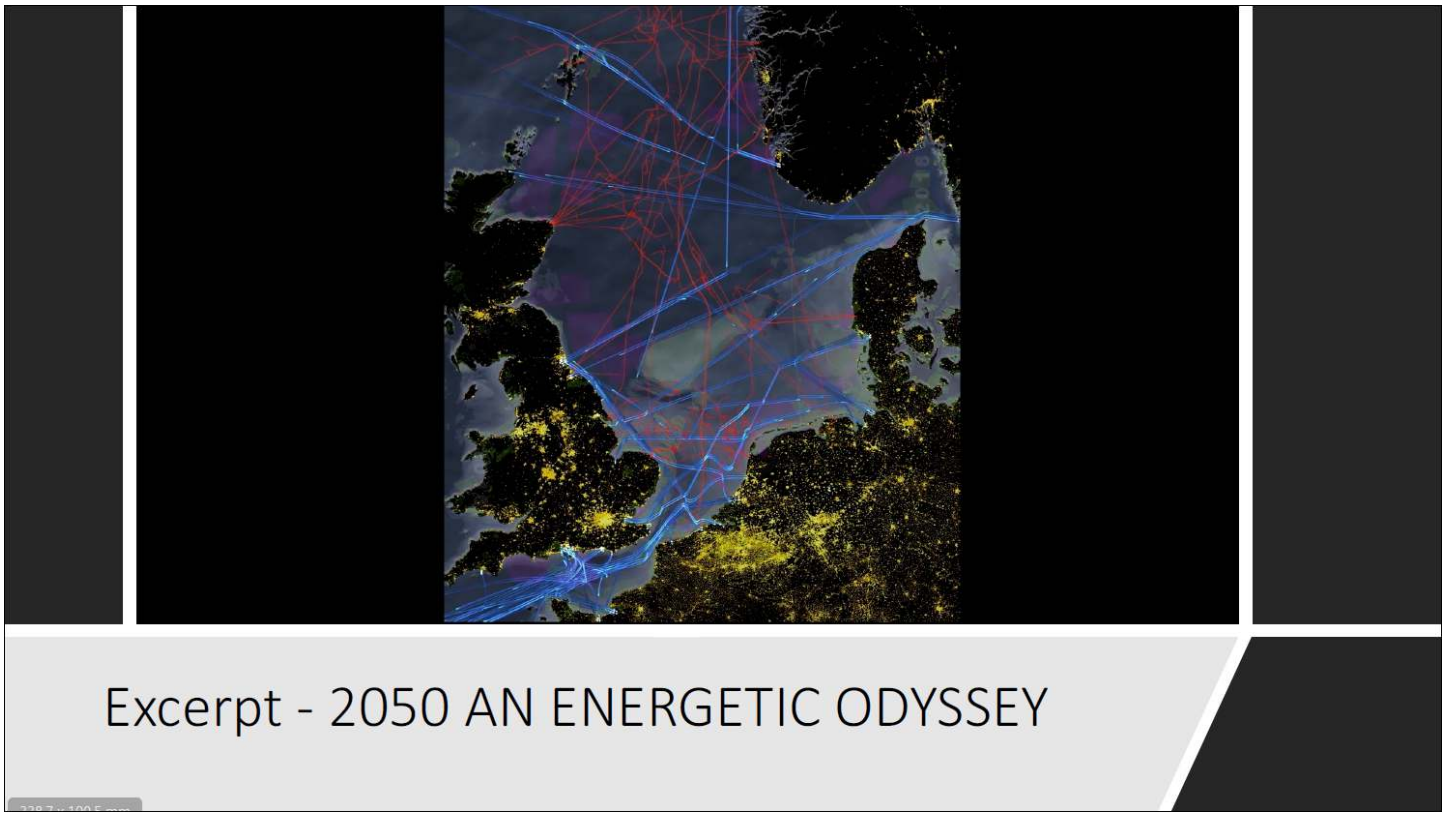
THE NORTH SEA AND ENERGY TRANSITION

2050 – AN ENERGETIC ODYSSEY

- The European climate objective – 80 to 95 percent reduction of greenhouse gas emissions in 2050 compared with 1990 – requires significant system changes. 2050 – An Energetic Odyssey shows how far-reaching the energy transition from fossil fuels such as oil, coal, and gas to an energy supply largely fed by renewable energy sources actually is. It is a (spatial) task that is still largely underestimated.



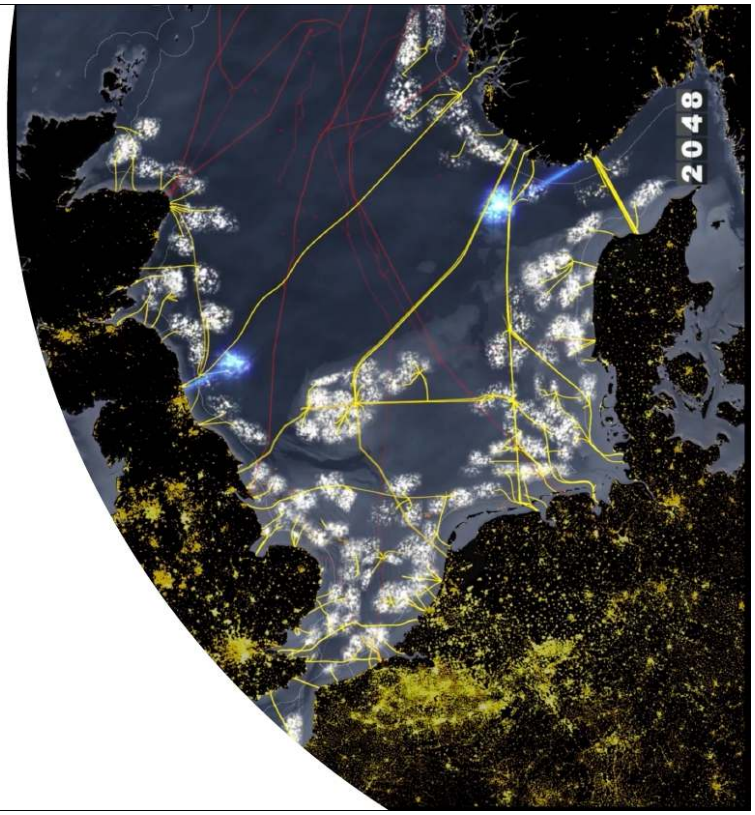
Trailer - 2050 AN ENERGETIC ODYSSEY



Excerpt - 2050 AN ENERGETIC ODYSSEY

MORE?

- The full video is available via the website iabr.nl and on Vimeo.

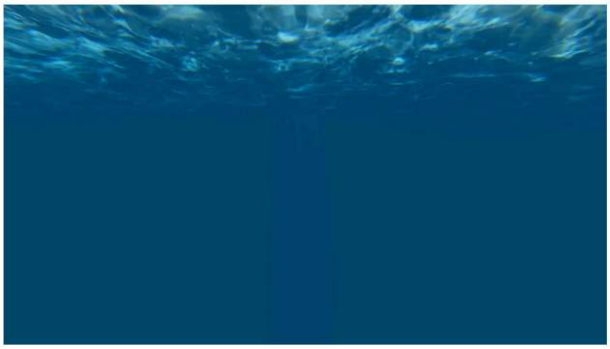


One of the first steps on our path to 2050

- A European offshore Power Hub located on the Dogger Bank

A big sandbank in the centre of the Northsea

Water depth of ± 18m

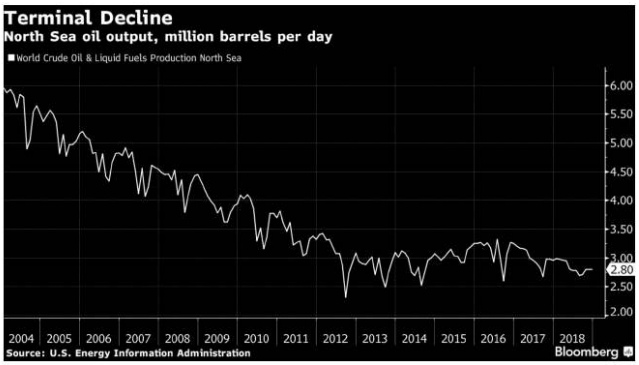


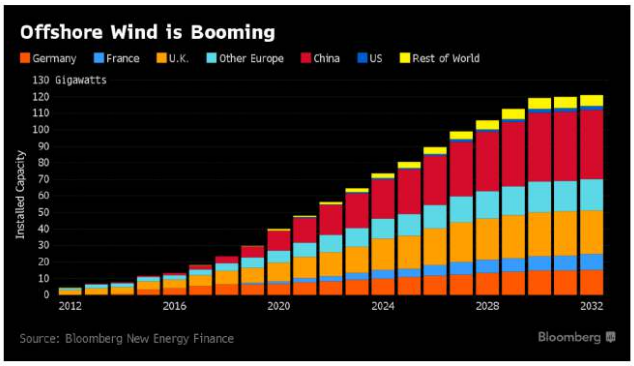
Central Power Hub

A concept prososed more than 10 years ago

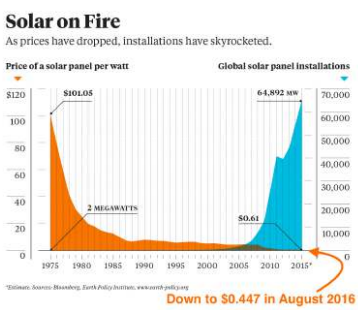
DCA

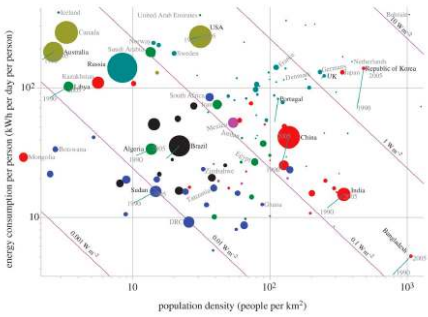
HDD-First

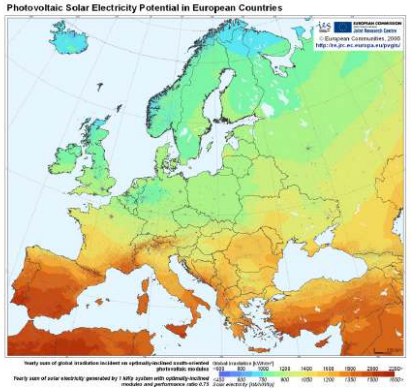




Wind grows while oil dwindles







What about solar?

Because western European countries are populated too densely we have to take to the sea to cover our needs.


Thank you
meewind

UNDERGROUND ELECTRICAL LINES

2 HDD's under Paris Charles de Gaulle Airport

Turn-key project for the construction of 2x 1500m HDD lines designed to set-up HDPE bundles for 225kV electrical cables.

Work schedule from September 2015 to March 2016.

The two drillings took 10 weeks and successfully crossed the airport runways without any impact on any airport's activity. The two power lines came inside the high security zone with not a single security issue.

The HDD solution was clearly the master asset of RTE for this project, ensuring the schedule and the security of the site.

A tight airport situation

01

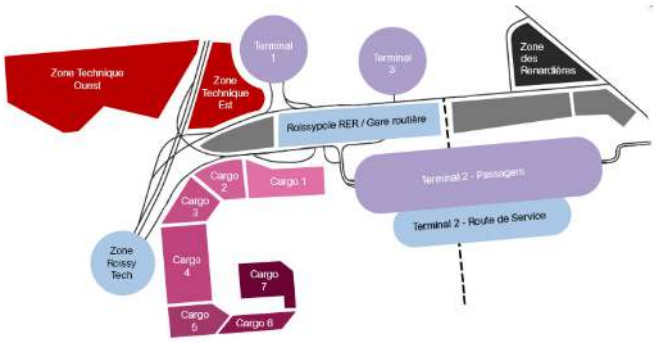
- These are Paris Charles de Gaulle Airport's characteristics :

⇒ 4 runways
⇒ 480 planes per hour,
i.e. one every 13 seconds.
⇒ 300 ha of utilised cargo
⇒ 6 000 tons of freight per day
⇒ 110 000 passengers per day.
⇒ The only European airport capable of receiving the A380 aircraft.

- In line with the « Great Paris » project, *Aéroport De Paris* (ADP) have initiated a Charles de Gaulle Airport development plan, aiming to build a new terminal within 15 years: The 4th terminal.

- The business purpose of ADP behind the creation of this terminal is almost doubling the number of passengers over the next 15 years to reach a total of 120 millions passengers per year and become the first European airport hub.

- This development is also achieved through renewing the existing installations with an effective capacity enhancement.
- The whole utility network optimization will be carried out on this platform until 2025: untreated water, waste water, electricity, jet fuel, etc.
- This enhancement will be carried through on a platform in constant operation without disturbing the passenger, freight and air traffics.



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One need

One customer

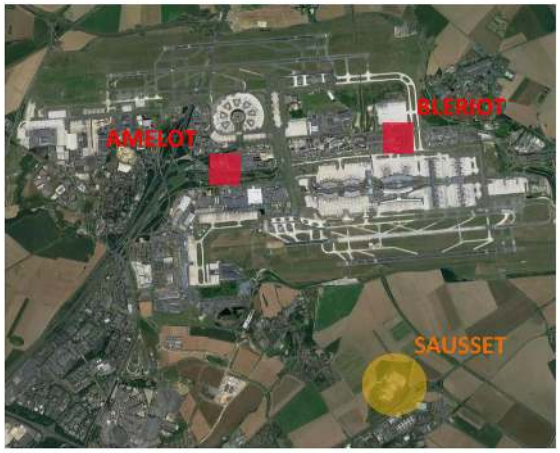
One project

02

Drilling Contractors Association (DCA-Europe) Topic: „HDD link for 60 million users“

HDD-First

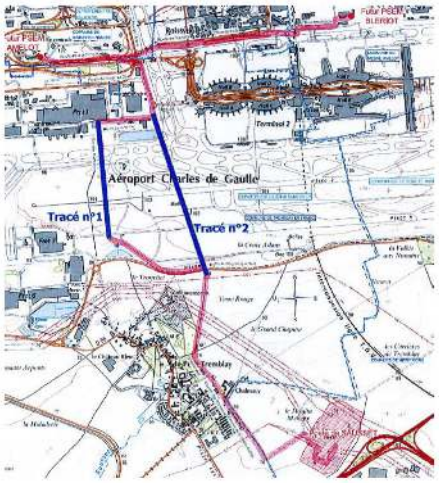
- A reliable supply of electricity is the key to the proper functioning of an airport.
- ADP requested RTE (Réseau de Transport d'Electricité), French 225 KV power supplier, two additional electrical interconnections from the only substation supplying the airport: the Sausset substation.
- The Sausset-Bleriot electrical connection will supply the new T4 Terminal. It will also meet the growth-related increased needs of the other terminals.



- A tense airport environment where delays amount to millions of euros.
- A global geopolitical context shaped by terrorism
- A strict implementation schedule

- RTE who have a legal obligation to carry out the works, soon became aware of the unusual aspects of this project and assessed in parallel a multitude of options for their 225 KV sub surface double electric connection, ranging from trenching to creating a technical room, to horizontal directional drilling and micro-tunnelling work.

- The areas to be reached were located in the heart of the airport and required the crossing of many aircraft runways, taxiways, etc.
- However, the penalties for any delay of traffic are colossal, so a trenchless solution began to emerge as the most credible alternative to carry out this project.
- Two alignments were then designed to go through the most direct route: the heart of the airport
- The call for tenders was issued by RTE in October 2014.

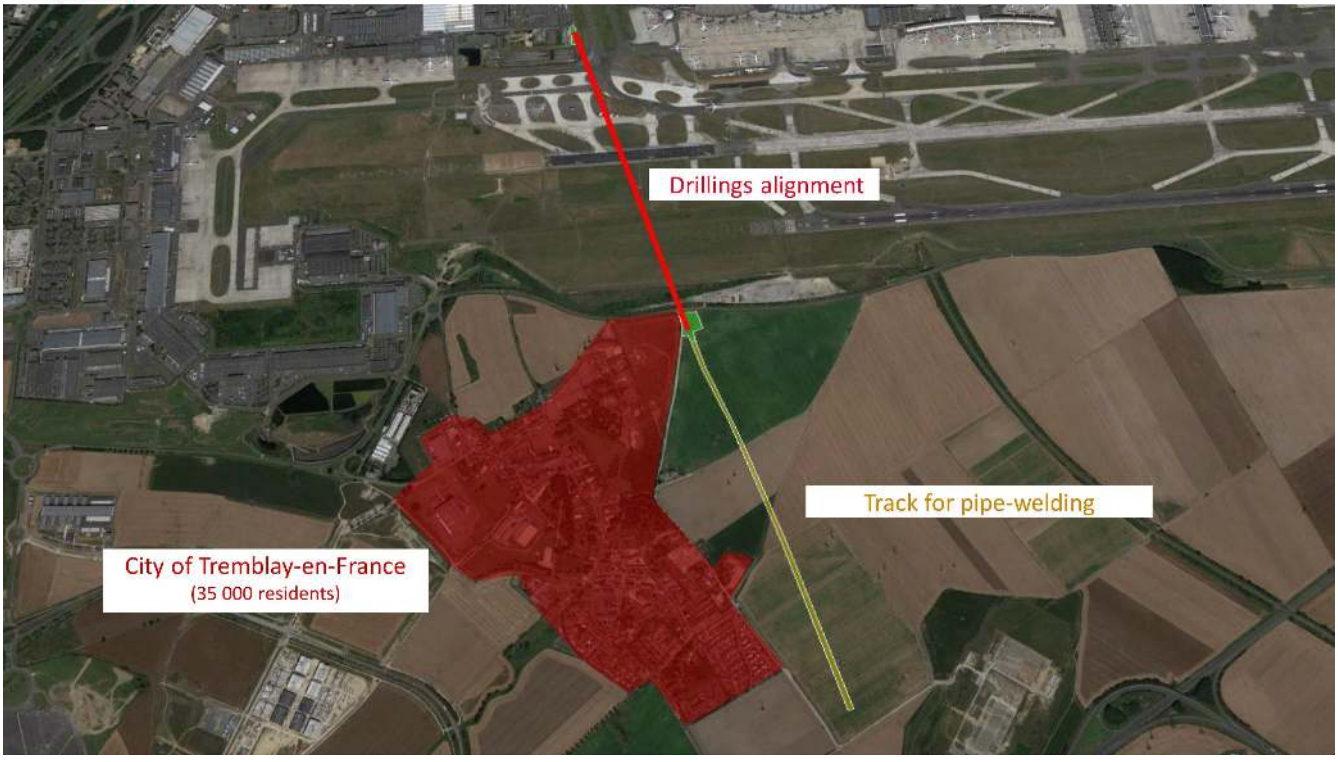


A pivotal study between main contractors and communities

03

HDD-First

- A very short two-month period was granted to companies to carry out an analysis of the two routes and offer a complete comparative study that would allow RTE to arbitrate according to their constraints.
- While the data provided during the tendering phase allowed preselection of a drilling route and a method design, they were incomplete and a lot of detailed explanation had to be undertaken with ADP to demonstrate that the Horizontal Directional Drilling method would have zero impact on the air traffic.
- Soon, the congestion of the site, its location in the airport and the need for space to prepare the steel and HDPE sheaths imposed the choice of the second route rather than the first one (please see aerial view on next page)



- The comparative analysis of the two route was nevertheless conducted, but only the detailed study of the second route (chosen alignment) was carried out from April 2015 to September 2015.

- The route was now traced and the major question now was to conduct the detailed study of the two longest horizontal directional drillings ever made for a sub-surface electric connection in France in only 6 months, which mainly included:

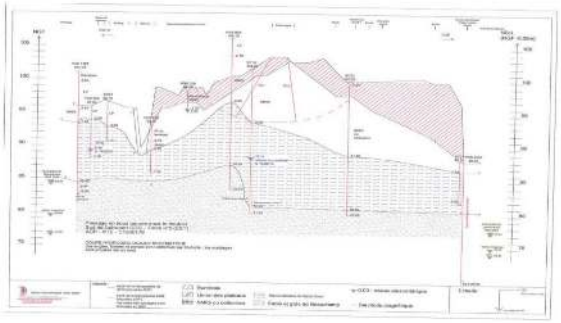
- Additional geotechnical investigations within the airport.
- Electrical soundings, tomography and seismic surveys within the airport
- Guidance systems impact surveys
- Analysis of the geotechnical results and development of the drilling method
- Impact assessment of the chosen methodology and validation by ADP and the Directorate General for Civil Aviation.
- Accreditation of personnel and equipment to enter the airport premises.
- Negotiation with landowners and town halls for the installation of our machinery and equipment.

1500m, and twice!

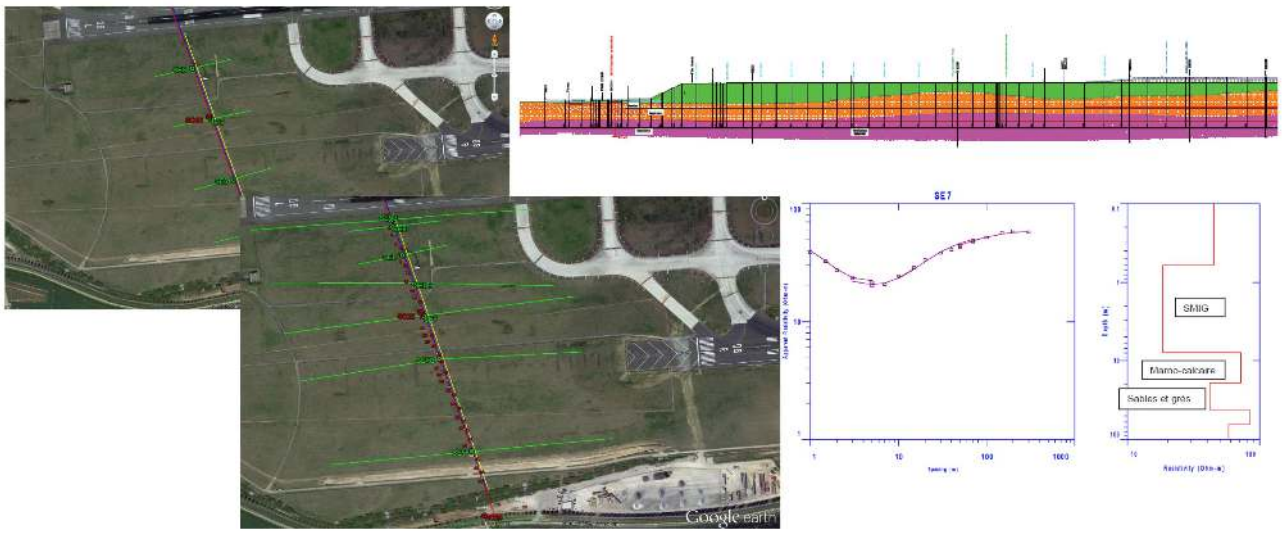
- The figure came out, formalised by RTE's order.

- It was simply the longest electrical connection ever installed by Horizontal Directional Drilling in France.

- While the elements originally transmitted allowed us to evaluate the feasibility of the works, it was now necessary to go into the detail of a realisation as complex as exhilarating.



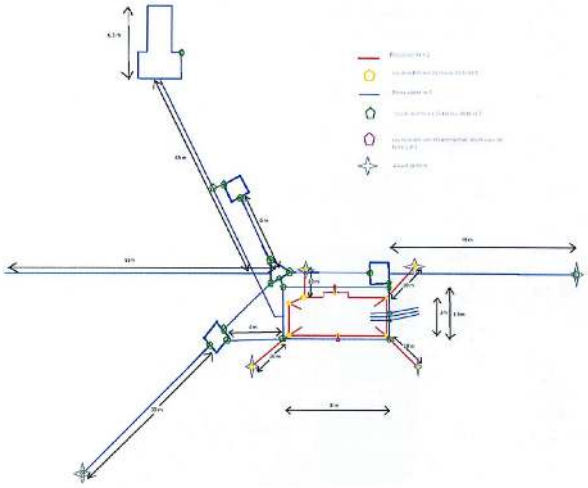
- We set up a detailed geotechnical and geophysical study program to scan the entire drill spindle.
- The task was complicated as it was necessary to enter the airport's narrowest area, the southern runways of the airport. In conjunction with the technical teams of ADP, we were able to mount a night mission over several weeks « almost » covering our 1500 m track. An area of 300m remained inaccessible to our investigations at the starting point of the drilling.
- Nevertheless, the results, which we analysed as soon as they arrived, were consistent, hence we could draw a reliable geotechnical profile and confirm the results of the preliminary soil study carried out by the client: RTE.
- On the basis of these results, the overall project price was confirmed without variation.



17

- Communication with airplanes was once again a subject of extreme sensitivity and was placed under the supervision of the DGAC (Directorate General of Civil Aviation). To simplify our task, this communication device was positioned in line with our drilling. It was, of course, impossible for the authorities to disrupt the operation of this giant antenna with an area of 1ha.

- Yet, the most commonly used system in our business on this type of horizontal drilling is precisely the generation of an artificial magnetic field to stimulate our guiding probe.



18

- The installation of this system, the Paratrack, on the surface also required that an operator could access the zone located along the axis of the drilling to install a cable, which wasn't achievable either in our context.
- We therefore opted for a method using an optical gyroscope for the first drilling and a buried Paratrack loop (in the first drilling) to guide the second. It was then necessary to calculate the magnetic field necessary for our guidance and to verify that its intensity would not disturb the « Glide path » system located 25m higher.

- The results were positive and confirmed that the chosen method was viable. Nevertheless, this method had to pass in commission to be validated, at the EISA (Aeronautical Safety Impact Study) led by the DGAC, before work could begin.

- The DGAC validated our guiding procedure and we thus had no interference –neither physical nor magnetic- with the activities of the airport.

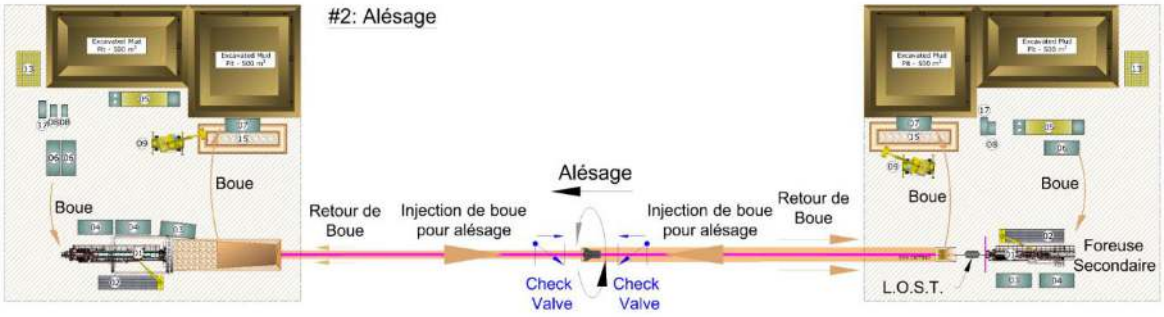
400 m³

- The final volume of bentonite generated for these works

20 000 m³

- The volume pumped during the only reaming phases of the drilled holes
- Such volumes can hardly be transited by road, this is all the more true in an airport enclosure.
- Again, the key word was, no impact!

- No impact meant that we couldn't' t install a mud return line on the surface and we did not have enough corridor to drill a buried mud return line.
- HDI has developed a device, called LOST, which makes it possible to pump mud regardless of what side of the drilling the returns of mud arrive.



21

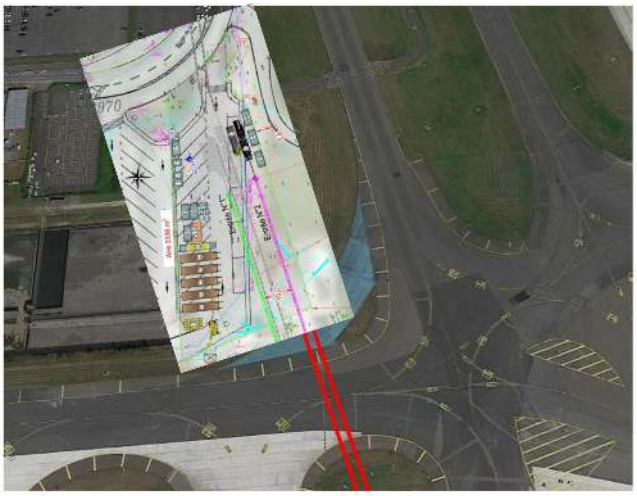
- The outer right of way to the airport (green and yellow on the map) was located in the town of Tremblay-en-France (red on the map)
- No less than 4,5 ha out of 5 agricultural plots were used for the establishment of the base-camp, drilling equipment, for the storage of sludge, soil spoil and pipe welding
- A communal road was completely redesigned for the benefit of the city and an old classified roman road was protected within the drilling site

22

- The pipe preparation track was then 20m wide by 1520m long.
- The general planning of the project was managed by HDI, and the rehabilitation of the path portion was even slightly ahead of schedule, which enabled the farmers to exploit the 3,5 ha equivalent while HDI paid them compensation.
- In the end, all the sites were repaired on time and no reservations were noted by the concerned parties (farmers, town halls, etc.)

- Earthworks, which generated **20 trucks per week** over 3 weeks before the drilling workshop mobilisation.
- Installation of **two 120 tons** gantry cranes for the installation of the drilling workshop
- **20 trucks** of **HDI** equipment to be certified and checked by the PAF and the Customs during entry on the airport platform.

- All equipment and movements of equipment were previously identified and validated by ADP, the installation of the cranes on the edge of the runways had to be endorsed by the control tower.



- To be allowed to enter Paris Charles de Gaulle Airport and for each employee:

- A complete administrative record had to be filed
- An administrative investigation was carried out.
- A two-days training had to be passed and validated.
- An airport airside driving licence had to be passed and validated

- These procedures required more than 2 months per file before being completed and a personal access badge issued, that had to be presented upon each entry for gaining access, while the staff and vehicles were being submitted to a search.

- More than 40 files have been managed by HDI on this project to cover all our activities. Only salaried employees were eligible to this access.

- Once all the studies had been completed and the methodology established,

- Ground additional investigations had to be re-checked.
- The final route of the drilling had to be validated.
- The appropriate drilling methods had to be validated.
- The choice of the drilling tools had to be validated.
- HDI had to ensure that the G3 mission follow-up was in place.

- All the points having been reviewed, the validation of the whole was recorded and the drilling of the first hole began on 11/04/2015. The schedule was adhered to.

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Project execution

Or the art of accommodating the work to the soil

04

Before proceeding to read on, please take time to watch the film that complements it

Watch the film (click on the link) => Project Movie

- Before starting the drilling work, we had to lay out our base camp, platforms and weld tracks for steel tubes and HDPE pipes.
- Indeed, on 1500 ml, the frictional forces would have been too great for DN 200 DHPE pipes. We therefore chose to install DN500 steel sheaths to reduce friction forces on the DHPE and ensure the entirety of their sheaths to RTE.
- The steel sheaths would also ensure the correct distribution of the thermal slurry at the end of the work.

- Two maxi-rig drilling workshops were mobilised for this project, a 400 tons workshop in the airport, and a 100 tons workshop on the outside.
- More than 20 trucks of equipment were transported to ZSAR (Security restricted access area) under customs control. Each truck and driver had to be accredited to be able to enter this restricted area and each and every incoming equipment was inspected.
- A good coordination with the airport authorities enabled this mobilisation to take place in just five days.

- The start up of the drilling work could begin within the expected time according to the established methodology.
- After the installation of a DN 350 tubing over a length of 50 ml, the drilling of the hole was properly started.
- Soon, the drilling parameters and the position of the head appeared unsatisfactory. The reading of the parameters (Torque, thrust force, position announced by the Gyroscope) did not correspond to what was expected within the planned geology
- We had enough room to achieve 2 parallel drillings, no more, hence priority was given to investigations.

Project execution
The first pilot hole

- The hole was taken up several times, sometimes seeking to border upon the limits, in order to record a maximum of parameters:
- Hardness of the soil
- Soil samples record
- Checking of the positioning of the tunnel with another probe to compare with the results given by the gyroscope.

- Without question, this was the most complex phase we had to manage during the project. We had meetings with the client almost on a daily basis keeping in mind the imperative of the upcoming links implementation date .

- Thanks to successful achievement of the G3 investigation mission by means of excavated earth surveys, we managed to overcome our difficulties.

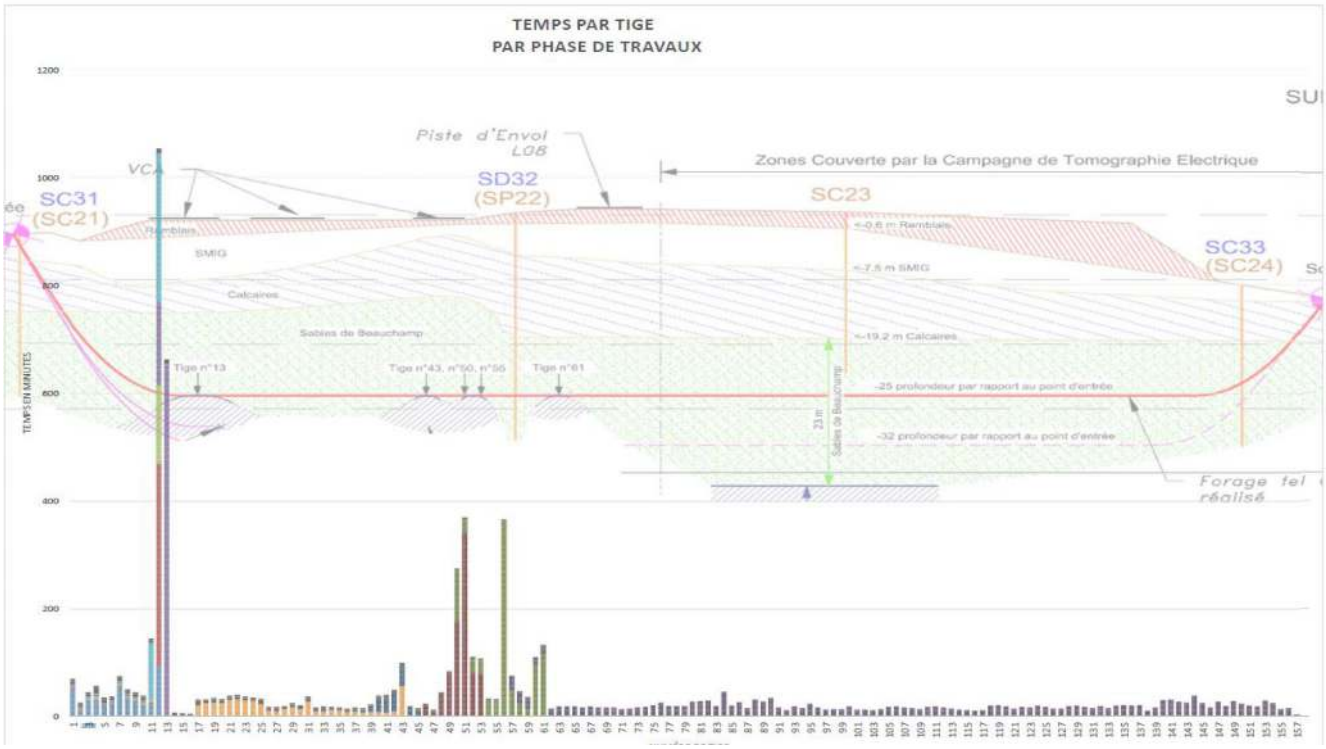
- The drilling cuttings were analysed on-the-spot, after a thorough wash to remove excess bentonite, the cuttings were observed using a magnifying glass.

- From the 21st drill rod onwards limestone was appearing amongst finer elements, probably Beauchamp sandstone and sand
- The appearance of carbonate cuttings pointed out the presence of marls with underlying stones which seemed to be at a higher level than expected.

- (We were in the only area where a geophysical survey could not be undertaken)

The following page summarises our geophysical survey report, enabling a subsoil geological composition map.

From then, the drilling layout could be adapted and all phases went according to plan.



- Further to the soil analysis modification, the reaming and pulling of the DN 500 steel sheaths went smoothly as per the schedule announced to the customer.. The analysis time at the beginning of the project was the sole delay added to the general schedule (1 month)

35

36

Project Execution
Continuation of the horizontal drilling – Pulling the DN 500

- The installation of DN200 HDPE sheaths on a 1500m section required some care to avoid peeling-off this ductile material.
- The preliminary installation of a DN 500 steel sheath was an imperative to reduce frictional forces.
- The steel sheath was filled with water as well as the HDPE pipes, which enabled us to remove almost completely frictional forces.
- Only 3 tonnes were necessary to pull these pipes.

- Once the HDPE installed, tried and tested, we injected thermal slurry between the HDPE and the steel sheath.
- The pressurisation of the assembly and the injection by lowest point ensured that the filling was total without damaging the HDPE.
- After completion of the drying times, the final tests could be carried out for the purpose the works acceptance by RTE.

- Here came the ultimate part of our work, in which we gave up our work site far from public view, and which was our biggest achievement: To have carried out such works without leaving traces of our passage.
- 3 week had been necessary to return the site to its original state.
- The objective was achieved, the project had been carried out on time and no impact on the environment and human activity had been recorded.

A target, a leitmotif

Our customer's satisfaction

To be a worthy representative of our trade.

05

- We achieved two horizontal drillings of 1500m each and placed HDPE pipes inside within six month from the first ground-breaking.
- The objective agreed upon with RTE was met; the new 225kV power lines were inaugurated on June 8th 2017 with the authorities and all the stakeholders of the project.
- Conducting this work accordingly to rules of the art and conveying a structured professional image of a specialized team mastering the good practices and having a low impact was our greatest satisfaction.

- The longest single block sub surface works for an electrical connection .
- The use of an optical gyroscope to ensure a tight corridor and no disturbance on airport activity
- An innovative system for the management of drilling fluid without any mud return line nor any rotation of hydro curing trucks.
- No impact on the activity of the first continental European airport.

OMG

Problems in HDD are not new. Since the industry began, there have been many unexpected and undesired situations. At the start, in the late seventies, HDD was a sort of magic to a lot of clients and third parties. Failures were more accepted. Since then, the industry has matured, and there is more focus on the quality of the work. That said, sometimes expectations are not realistic. In this presentation we will show some examples of how it should not be done. It is not about shaming any company or party, but we should all be aware things can go wrong and if so, we should take the opportunity to learn from it.

Mistakes do happen. To us all. However it is not just the contractors who should shoulder the blame. The suppliers, engineering companies and pipeline operators should also share some of the blame and not simply lean back and enjoy a series of other people misery on their screen. Everybody in the HDD food chain is responsible for the mistakes that happen on job sites every day. Contractors are obviously an easy target, because they do the actual work out in the field and are responsible for the quality, inspection/maintenance of the equipment, competence of the personnel and selection of the tooling.
Saving pennies on soil investigations at the start of a project is not a good preparation.
Design of profiles should not be to a minimum allowable radius. We all know steering is dependent on more than the theoretical accuracy of a tool.
Suppliers should not always advise their product if it is not the most suitable. Sometimes it is better to buy more suitable material or equipment somewhere else, or simply ensure that products are used in the correct manner by proper instruction and sometimes advice taken on the job site.

Mistakes are made in every industry and in everybody's life. Just have a look on google and you can find endless quotes about it. Mistakes in the HDD industry are not scarce but have certainly become more rare with time, at least relatively speaking. With the boom in the number of drills executed nowadays, it is positive that there are only so few major problematic drills per year.
In this presentation some examples will be showcased. They will only discuss mechanical and design issues and not go into the horrific incidents with bodily harm, as this is another subject altogether.

Design/Engineering

In the design and preparations there is a lot of room for improvement. Although there are design guidelines (a.o. the DCA Technical Guidelines) that make recommendations on required number and type of soil investigations, cover and radii, contractors still come across surprising and sometimes even deceiving drawings.
Recently, a client asked contractors to bid on the construction of a 40" steel water main. In the client's specifications, a reference to the NEN 3650 was made. A minimum design radius of 1200 m would therefore have applied. In the drawing that was also submitted with the tender, a combined radius of less than 850 m was detailed because the effect of the severe horizontal curvature was completely neglected. The overbend was indicated at a depth of 9 m BGL simply ignoring actual ground level.

The length of the drills was approx. 600 m with a max deviation allowed of 40 cm, which was not realistic, and in this case not necessary either. How should a contractor bid on such a project? Simply put a price based on length x diameter and in case of contract award raise objections? Or ask questions in the bidding phase or submit a qualified bid with the risk of being excluded?

Out on the job site, things do not always go as planned. In the following various situations, things have gone wrong causing losses in both time and money.

On a job site in the United States a contractor installed a casing pipe by hammering. The design was not thought through very well. The wall thickness was clearly not enough to absorb the forces during the hammering of the casing, resulting in the pipe going flat. Since this was underground, it was only noticed when the drill pipe did not advance once the pilot drill was started. This resulted in a lot of lost time, as the pipe had to be removed, and another one installed before the pilot could be re-started.

Installed casing pipe not strong enough

It is not only underground where the problems occur. The equipment above ground is equally important and must therefore be well maintained. Failure of any of the equipment will lead to down time but failure of equipment at crucial times can cause serious problems. This does not only apply to the rig but also mud systems and other specific equipment. Stupid things such as a vacuum truck breaking down can stop the whole process. Pull back is obviously a critical stage, but in unstable holes where working 24/7 is required to make the job a success any interruption of the works may lead to a perilous situation.

As an example, on a project in the USA, while pulling only 820 m of 36” steel pipe, the seal of the 250T rigs’ power pack was blown with only 120 m to go. After a 3 hr repair, the pipe would no longer move. A hammer had to be brought in and connected, resulting in a week’s delay. Once the hammer got the pipe moving again, pulling forces to finish the pull in were at the same level as before the problems started, only just over 100 tonnes. The contractor was lucky here, if they had not got the pipe moving, it could have gone further wrong, with the pipe stuck forever.

In HDD the use of a drilling fluid, or mud, is required. A very useful attribute, but it can cause a lot of problems if not handled with care. The product itself is not environmentally damaging, but still it can lead to problems. It can frac out to surface, where it could lead to serious damage or just messy situations. In the field this may not require much more than simple containment and pumps, but when under a motorway it may lead to serious damage to the road structure. In rivers and ditches it will be much more difficult to remove and depending on the use it may lead to problems for the people downstream.

Frac out of mud into a ditch in Suriname

Even when circulating the annulus to the surface, situations are known where e.g. reamers were in a stationary position, while flushing, which created cavities under roads, leading to collapse.
Mud that is not directly related to the actual drilling of the hole can lead to undesirable situations.
Tanks may overflow, causing a muddy (and unsafe) work site or even damage to the surrounding area. In the adjacent picture, the equipment was set up on top of an underground parking facility, the tanks overflowed and the fluid ran into the carpark covering the cars in mud.

Cars in underground carpark covered in bentonite

Broken drill pipe

The underground equipment, drill pipe and parts of the BHA like reamers, hole openers, centralisers etc are obviously a very critical and vulnerable part or the operations. Since it is impossible to look for surprises underground and that the information as provided does not always match the reality, the tools may be subject to more challenges than expected.

On the other hand, proper quality systems in manufacturing and maintenance of pipes and tools, as well as instructions to the personnel about limits of the down hole tooling can eliminate a lot of the problems incurred in the industry. The combination of push/pull forces, torque, rpm and radius is quite a challenge for the pipes but it is not always recognised that they all have an influence on each other.

The thread in the tool joints is obviously a very vulnerable part of the pipe but as solid as a pipe may look, drill pipes certainly wear with regards to the wall thickness both on the tool joints and on the body. Fatigue can also play a part in the root causes for drill pipes breaking. Many companies have learned the hard way that when using large diameter reamers it is a requirement to use smaller centralisers, stepping down or heavy weight drill pipe.

The three most important ways to prevent drill pipe breakages from happening are inspection, maintenance and proper instructions to the drillers.

Drill pipes (and other tools) are subject to harsh conditions and will naturally wear on body and tool joints. Periodic inspection will show remaining wall thickness and condition of the threads. Threads can be repaired/recut until the tool joint becomes too short. When the wall thickness is reduced too far, the pipe will be ranked in a lower class. There are no objections against using such pipe, as long as the driller is aware of this and limits the forces on these pipes. Often drillers have not been informed about the maximum allowable forces that can be applied. With a strong enough rig, damage is easily done.

Too much push on drill pipe

Anything in the hole apart from the drill pipe is referred to as the Bottom Hole Assembly (BHA) and this is also subject to a lot of wear. The BHA will normally have the same connection on the central collar as drill pipe but will also include a lot of welded on parts. Both the collar and the welded parts must be inspected regularly. During use, tools will wear and sometimes this will go faster than expected. The outside of a 40" reamer pulled at 1m/min and 30 rpm in a 1000 m long hole will have scoured against the formation for more than 30 km! Apart from that, most drills will go through a variety of formations, which would ideally require different tools. However, tripping in and out all the time is not realistic. The wear of tooling will also depend on driller's behaviour, pulling too fast or not pumping enough drilling fluid will result in higher wear.

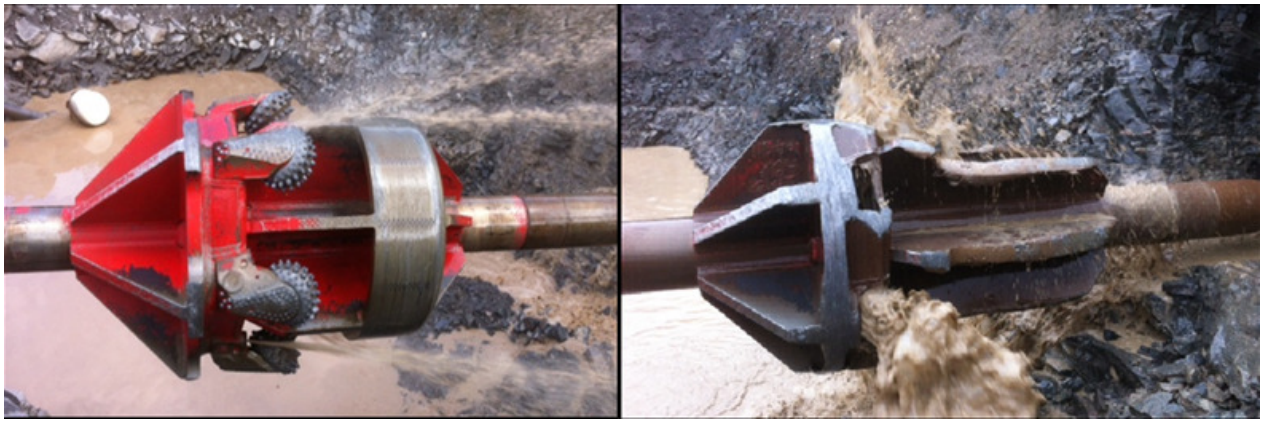
Wear on fly cutter. Note all teeth on outer ring are gone

Parts may fall off, which need to be fished out of the hole as they could form an obstacle to further reaming steps or may damage the pipe or coating during installation. Worn tools will give reduced or no progress and need to be tripped and possibly repaired

Two pictures of the same tool after 4 resp 79 hrs in the hole

Once the hole is completed the pipe can be pulled in. During this last step in the process many things can go wrong; the drill pipe or a part of the BHA can break, the pipe itself or the coating can be damaged or the pipe can get stuck. In some cases, if pull back fails shortly before completion, it may be possible to make the connection to the adjacent pipe by installing a deep sheet piled pit. Most of the

times however, any of the above will require the pipe to be pulled out back the way it came in, or if this proves impossible to be cut off abandoned and re-drilled.



Pipe pulled out of the hole after failed installation Coating damaged during installation

It can be concluded that many things could go wrong in the HDD process. But also that a lot of issues can be mitigated by having appropriate controls in place. The use of best practice by experienced personnel and correct instructions about the limits of the above and below ground equipment will help to avoid many unwanted situations.

"HDD-Trouble-Shooting"

"You can avoid mistakes if you gain experiences. And you gain experiences if you make mistakes"
(Laurence Johnston Peter (1919-1990), American management consultant).

The DCA as technical association of the HDD industry has set the goal to create a kind of "failure management" among its members. Failure does not necessarily mean lack of performance, however; rather we understand it as deviation from the original plan. False estimations and misinterpretations (for example in geology) are also relevant of course. HDD contractors in the DCA are reasonably aware what unplanned and unwanted incidents can impede the works or cause additional efforts in practice: loss of drilling fluids, blowouts, breaking bars, tool wear - these are just some items on the long list of problems that have to be solved. If it is anyhow possible we prefer to shut these experiences away in our company. Or we well treasure these experiences and estimate them as a future advantage in competition. But instead we should increasingly and associated avail ourselves of just these experiences; then we can effectively augment the quality and reliability of the HDD method in its entirety. Finally all regular HDD members are competing together both with conventional pipe laying and with other trenchless construction methods.

For that reason the DCA wishes, together with its members, to address ourselves to this task and delve into this issue with a panel discussion during our annual congress. First vice-president Jorn Stoelinga will provide some succinct insight titled "OMG"; the ensuing panel discussion will be based on five carefully chosen complexes of topics that are each introduced by board members in short presentations. We will discuss both topics from the large-scale industry as well as from the field of smaller or medium facilities. The round will be presented by Franz-Josef Kissing of Open Grid Europe who, from the clients' view, will surely contribute instances of difficult constellations during HDD drillings. The board members are hoping for active collaboration from the audience. It is planned for the beginning of 2018 to consolidate some important aspects from this discussion in a one-day exchange of experiences..

Introduction speech: Thursday, 05th october 2017, 12.00 p.m.

"OMG", Jorn Stoelinga, Visser and Smit Hanab b.v.

Topics of the Panel-Discussion

HDD-Trouble-Shooting?
Problem statements, challenges, solutions

- Equipment
- Geology
- Cooperation - Clients - Consultant - Drilling contractors - Supplier
- Drilling fluids
- Pipes, Coating, Overbend

Moderator:	**Dipl.- Ing. Franz-Josef Kissing, Open Grid Europe,** **Representative for Technical Information**
Podium:	Dipl.- Ing Marc Schnau, Bohlen & Doyen GmbH Jorn Stoelinga, Visser and Smit Hanab b.v. Dipl.- Ing. Marco Reinhard, LEONHARD WEISS GmbH & Co. KG François Gandard, Horizontal Drilling Iinternational (HDI) Dipl. Ing. Günter Kruse, LMR Drilling GmbH
Time:	Thursday, 05th October 2017, 02:30 p.m. until 4:30 p.m.
Overall Direction:	Dipl.-Ing. Marc Schnau, DCA President
Language:	The panel discussion is held **alternately in German and English** A simultaneous translation into German / English and English / German is provided.

“HDD-Trouble-Shooting”

„Fehler vermeidet man, indem man Erfahrungen sammelt. Erfahrungen sammelt man, indem man Fehler macht“
(Laurence Johnston Peter (1919-1990), amerikanischer Managementberater).

Der DCA als technischer Verband der HDD-Industrie hat sich zum Ziel gesetzt, eine Art „Fehlerkultur“ innerhalb der Mitgliederschaft aufzubauen. Fehler sind dabei nicht zwangsläufig als Mangel in der Leistungsausführung anzusehen, sondern vielmehr als Abweichung vom ursprünglichen Plan zu verstehen. Dabei spielen naturgemäß Fehleinschätzungen/Fehlinterpretationen (z.B. der Geologie) auch eine Rolle. Den HDD Bohrunternehmen im DCA ist leidlich bekannt, was in der Praxis während der Bohrausführung an ungeplanten und unerwünschten Vorkommnissen die Arbeiten erschweren bzw. für zusätzlichen Aufwand sorgen kann. Spülungsverluste, Ausbläser, Gestängebrüche, Werkzeugverschleiß,… sind nur einige Punkte aus der Vielzahl an Problemstellungen, die es zu lösen gilt. Wenn irgendwie möglich, werden diese Erfahrungen gerne in den Firmen unter Verschluss gehalten. Oder die erlangten Erfahrungen werden als zukünftiger Wettbewerbsvorteil angesehen und daher gut gehütet. Gerade diese Erfahrungen sollen im Verband vermehrt gemeinsam zunutze gemacht werden, um die Qualität und die Verlässlichkeit des HDD-Verfahrens in Gänze nachhaltig zu steigern. Schließlich stehen alle aktiven DCA Mitglieder auch gemeinsam im Wettbewerb sowohl mit der konventionellen Rohrverlegung sowie auch mit anderen grabenlosen Bauverfahren.

Der DCA möchte sich daher mit seinen Mitgliedern gemeinsam dieser Aufgabe widmen und auf der Jahrestagung im Rahmen einer Podiumsdiskussion in dieses Thema einsteigen. Zur Einführung wird Vize-Präsident Jorn Stoelinga unter dem Titel „OMG“ erste prägnante Einblicke geben. Die anschließende Podiumsdiskussion basiert auf insgesamt fünf ausgesuchten Themenkomplexen, die von Mitgliedern des Vorstandes in Kurzvorträgen vorgestellt werden. Hierbei werden sowohl Themen aus der Großbohrtechnik als auch aus dem Bereich der kleineren und mittleren Anlagen zur Diskussion gestellt. Die Moderation der Runde hat mit Franz-Josef Kissing von der Firma Open Grid Europe ein Auftraggeber inne, der aus seinem Erfahrungsschatz sicherlich auch die eine oder andere schwierige Konstellation im Zuge einer HDD-Bohrung anbringen kann. Der Vorstand hofft hierbei auf eine aktive Mitarbeit im Rahmen der Veranstaltung. Anfang 2018 ist vorgesehen, wesentliche Punkte der Podiumsdiskussion in einem eintägigen Erfahrungsaustausch weiter zu vertiefen.

Einführungsvortrag Donnerstag, 05.10.2017, 12.00 Uhr

"OMG", Jorn Stoelinga, Visser and Smit Hanab b.v.

Themenbereiche der Podiumsdiskussion:

HDD-Trouble-Shooting?
Problemstellungen, Herangehensweisen, Lösungswege

- Equipment
- Geologie
- Zusammenarbeit Auftraggeber - Planer - Bohrunternehmen – Zulieferer
- Bohrspülung
- Rohre, Umhüllung, Oberbogen

Moderator:	**Dipl.- Ing. Franz-Josef Kissing, Open Grid Europe,** **Beauftragter für HDD Technik im Vorstand des DCA**
Podium:	Dipl.- Ing Marc Schnau, Bohlen & Doyen GmbH Jorn Stoelinga, Visser and Smit Hanab b.v. Dipl.- Ing. Marco Reinhard, LEONHARD WEISS GmbH & Co. KG François Gandard, Horizontal Drilling Iinternational (HDI) Dipl. Ing. Günter Kruse, LMR Drilling GmbH
Durchführung:	Donnerstag, 05. Oktober 2017, 14:30 Uhr bis 16:30 Uhr
Gesamtleitung:	Dipl.-Ing. Marc Schnau, DCA Präsident
Sprache:	Die Podiumsdiskussion wird **abwechselnd** in **deutscher und englischer Sprache** durchgeführt.

Everything you always wanted to know about wireline steering but were afraid to ask (Dan Billig)

What is the History of Wireline Guidance Systems?

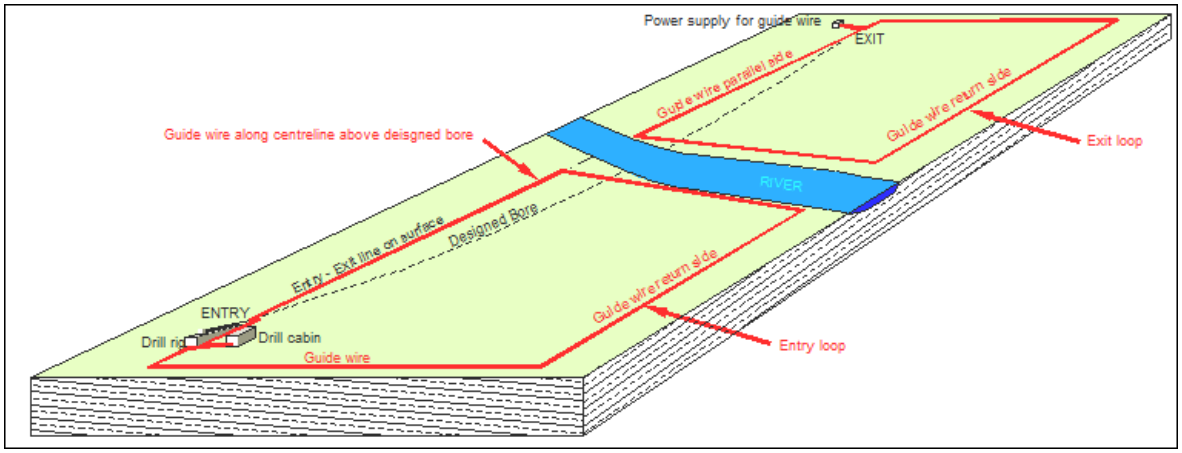
Wireline guidance systems have been in use since the beginning of the HDD industry and have developed significantly through the years.
The largest early breakthrough was the addition of tracking capability to the guidance system. Previous to this, guidance systems relied on only a magnetic azimuth and inclination data during the drilling process. This had the potential for cumulative errors resulting in significant deviations by the end of the bore.
For systems without tracking, setup was somewhat complicated as it was necessary to perform a probe-shoot prior to starting drilling. This would involve setting up the entire drilling assembly in a magnetically clean environment, aligned as closely as possible to the drillpath direction, therefore calibrating the azimuth to the local conditions of the project.
Now all currently available wireline steering systems allow for secondary tracking with various levels of potential depth and accuracy.

What is the concept of a Wireline Guidance System?

All wireline guidance systems operate using the same basic principles. Each has the ability to separately calculate and measure its position.
A useful analogy for the difference between calculating and measuring location is that of sailing. When the night is clear and the stars are out, a sailor will use a sextant to measure the height of a star or the moon above the horizon. This angle measurement to a fixed point in a known location gives the location of the vessel. Thus you have a physical measurement to give the location.
When this is not possible, the sailor would use a compass to determine what direction they are travelling in and by linking this to the speed they had been travelling they would be able to calculate their location.

What Secondary Tracking Methods are available?

When secondary tracking was first introduced to the HDD market, is was based around a cable being laid in a rectangular shape around the drill line. A high DC current was used to energise the cable. Due to the DC nature of the electrical signal, high currents were necessary (upwards of 100A in some cases). This would limit the size of the coil to a couple of hundred meters in total cable length.
The Paratrack system revolutionized the concept of secondary tracking by ranging to the cable energized to AC signals rather than DC signals. This enabled the system to average multiple readings quickly and to actively filter out any unwanted noise. This allows for much longer surface cables (over 6Km is possible with standard cable) as well as using tracking sources which are not necessarily cable based.
With this increased range and accuracy many of the inherent risks associated with guidance while drilling the pilot hole were removed.

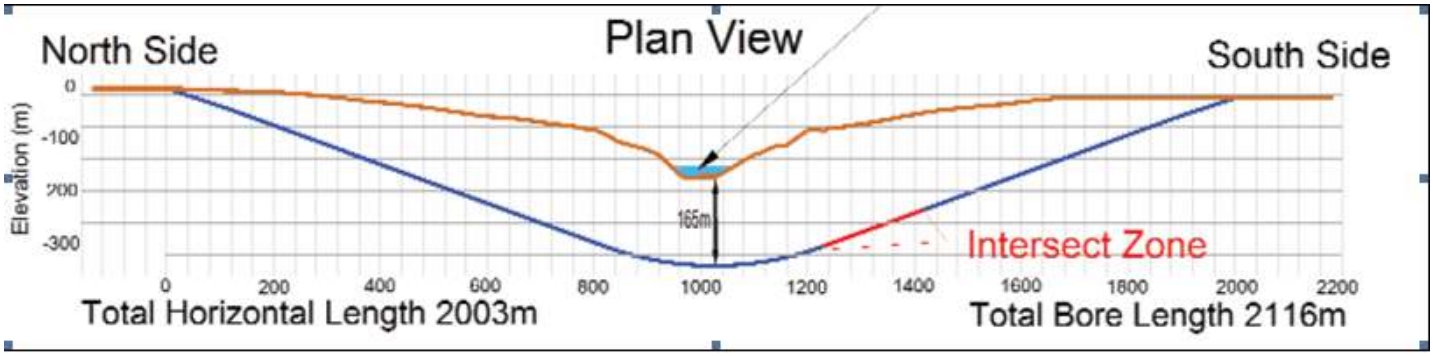


Standard Surface Coil Setup for Paratrack II System

Surface / Underground Cable

As described above, the introduction of AC enabled lower currents to be used (typically around 6A) over much larger distances.

The below project in Canada utilised a surface coil which was still ranging accurately at depths of approximately 200m.



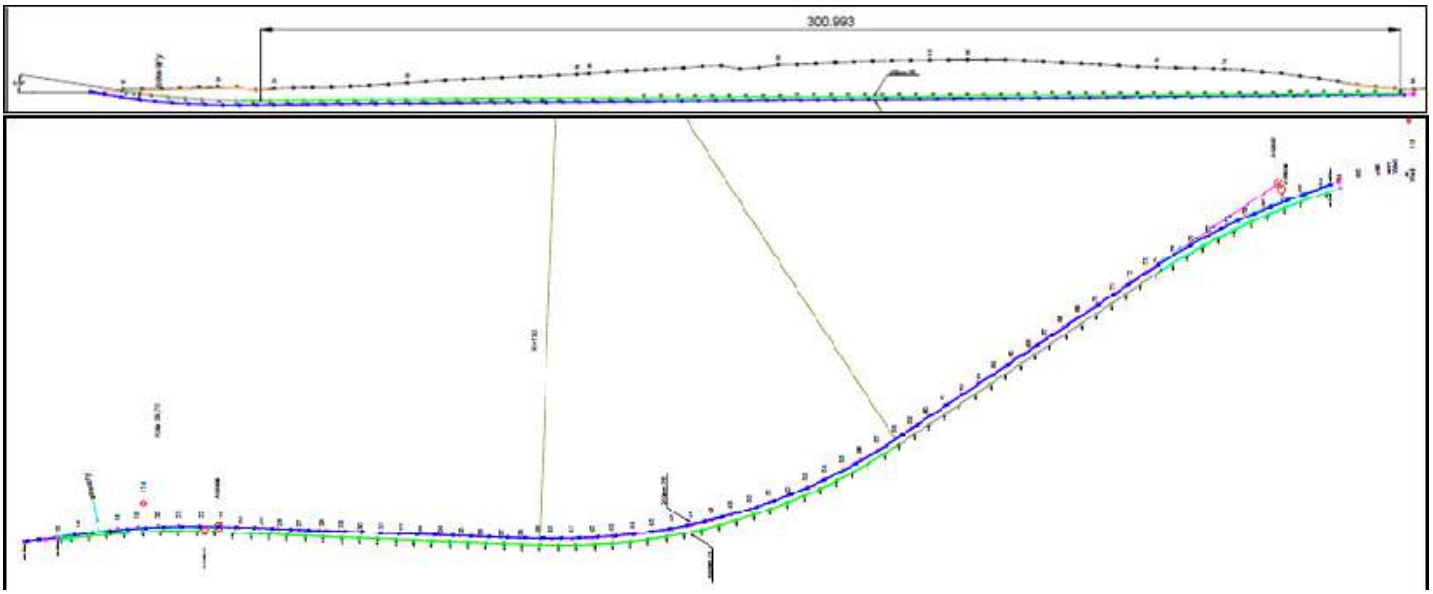
Profile of Bucking Horse River Intersect in Canada.

The point should be made, that when the system is outside of range of the secondary tracking system, the calculation method can then be used to continue drilling. On this particular project, this enabled the pilot hole to be drilled to a total vertical depth (which is the vertical distance below the entry point) of 300m.

Coils can also be made small enough to insert into a sacrificial borehole which can be used to range from in high accuracy parallel tunneling applications. An example of this is a project completed in Naples for the subway system constructed there.

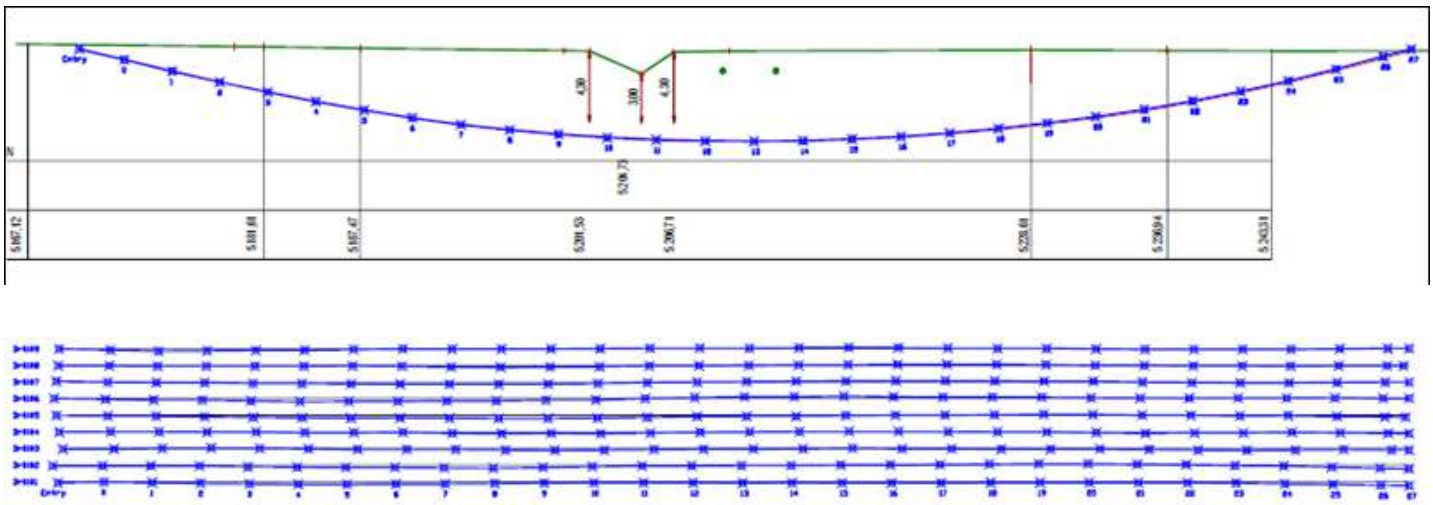
The possibility to install and range from underground cables gives the HDD contractor the possibility to perform close proximity and high accuracy parallel drillings such as the below project which was performed in Denmark. Here a surface coil was used to drill the first crossing. When this was completed, a cable was installed inside and this was used to guide the second crossing. The separation bet-

ween the two drills was 1.7m and the crossing was 350m long. This project was further complicated by the significant horizontal turns made during the drilling.



Profile and Plan View of 2 x parallel 350m crossings in Denmark

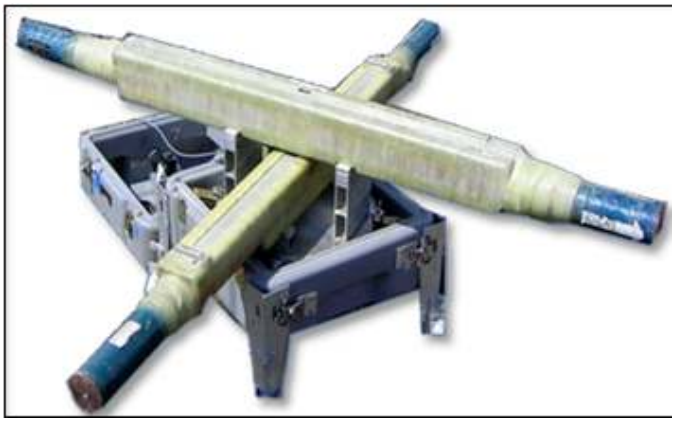
Another similar project was this one performed in Germany. Here there were 9 parallel crossings 90m long, with a separation of 1m between them. The same guidance principle was applied on this project, the first pilot hole was drilled and a cable installed inside. The remaining 8 crossings were drilled ranging to this underground cable.



Profile and Plan Views of 90m parallel crossings in Germany

Beacon Tracking System / Large Field Beacon

These two systems are based on two long solenoids (copper wire wrapped around an iron core) which are arranged perpendicular on a levelled table (Fig 4). When energised these solenoids project an EM signal.

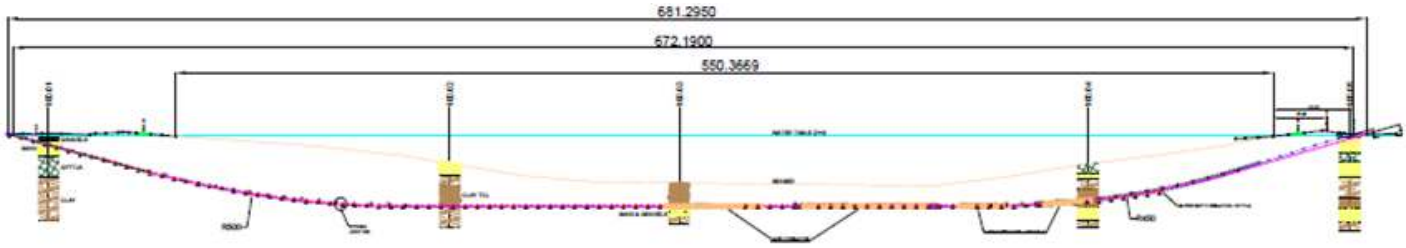


The Beacon Tracking System

The standard Beacon Tracking System can give accurate measurements up to 75m away. While the Large Field Beacon will give readings up to nearly 200m away. This enables position measurement where it is not possible to install a coil over the top of or alongside the drill line.

The Large Field beacon

The increased measurement distance of the large field beacon has given the potential for increased accuracy and therefore lower operational risks on certain projects where access to setup a surface coil might not be possible.
This was indeed the case for a project which we completed recently in Denmark. Technically this was a challenging project for the Paratrack system as it involved a wide stretch of water with limited space on entry and exit sides. The HDD contractor was already a Paratrack owner so renting the Large Field Beacon was an economical solution for them.



The Profile of the Oddesund Crossing

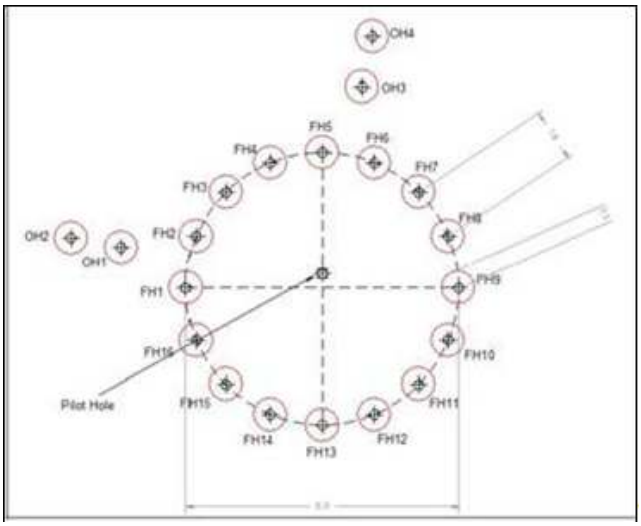
Location of the crossing – the drill ran parallel to the bridge shown in this drawing

Magnetic Ranging Systems

The magnetic sensitivity of the Paratrack probe enables it to perform accurate downhole ranging. This is a measurement taken while both the probe and the magnetic source are downhole. The ability to perform underground ranging has driven the now common technique of HDD intersects. By enabling a very low risk methodology for completing intersects where there is no possibility for other secondary tracking methods the “meet in the middle” method has become a standard method used by many HDD contractors when considering challenging projects.
There are two downhole ranging methods employed by the Paratrack probe, Passive Magnetic Ranging System (PMRS) and Rotating Magnet Ranging System (RMRS). As the names suggest, one is based on a static magnetic source being moved past the sensor, while the other uses a rotating magnetic source moved past the sensor.
The use of magnetic ranging systems is not just limited to HDD intersects, but has also found applications in other projects, for example tunneling and civils projects. The Hallandsas project was a good example of this, enabling 100m long, close proximity boreholes to be completed in a granite for-

mation. By using a rotating magnet sub placed between the bit and the motor, it was possible to accurately range (in three dimensions) to the bit of the motor rather than the probe located behind the motor.

Rig used on Freeze hole drilling in Hallandsas



Borehole arrangement in Hallandsas

The tolerances for these boreholes was 0.5m over the entire length of the borepath. This tight tolerance was necessary due to the small (1.2m) separation of the planned boreholes. The boreholes were subsequently frozen and the entire area excavated, thus giving the opportunity to prove the accuracy of the system in a way that would not normally be possible on an HDD project.

What are the Operational Limitations for Wireline Guidance Systems?

Wireline Guidance systems can only be used with a certain minimum sized rig. Generally this will be determined by the size of the drillpipe being used.

The minimum OD for a Paratrack housing is 3”, though this is generally still ok to be used with rigs where the tool joint is just under this (eg 2 7/8” OD).

The rig should be equipped for use with a wireline system. These are available in many shapes and sizes, though even at their most basic they should allow the transmission of the downhole information

being generated when the drillpipe is rotating as well as stationary.

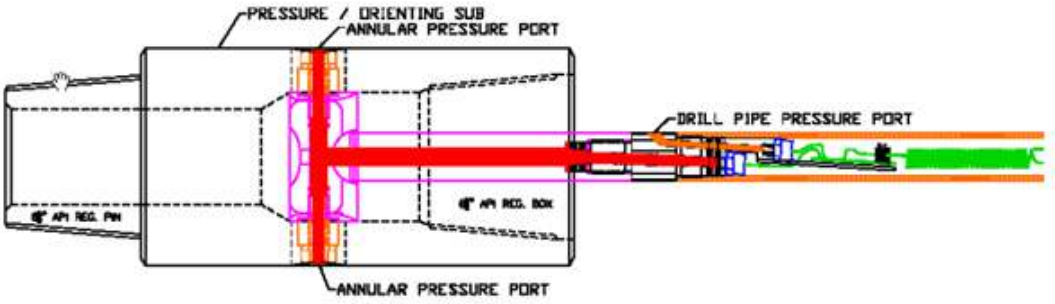
Minimum radius is also something to be considered when using or planning a wireline guidance project. The minimum possible radii when drilling with a wireline guidance system housing are generally larger than those achievable when using a walkover tracking system. If the contractor is unsure as to what this minimum radius might be, they should seek the advice of their service company prior to finalizing their HDD design.

What else can a Wireline Guidance System do?
The different guidance systems on the market allow for different capabilities, and most do offer some form of modular add-on with regards to extra real time downhole information. The Paratrack offers more options in this regards than others including:

At Bit Inclination Assembly
Using the ABIA when drilling with a motor allows the operator to measure the inclination at the bit, rather than at the location of the sensor behind the motor. This gives significantly increased radius control, especially useful when drilling pilot holes for large diameter steel pipes.

Pressure While Drilling
A useful feature of some wireline guidance systems is the ability to measure real time downhole pressures. In most cases it is possible to measure both pipe pressure and annular pressure.

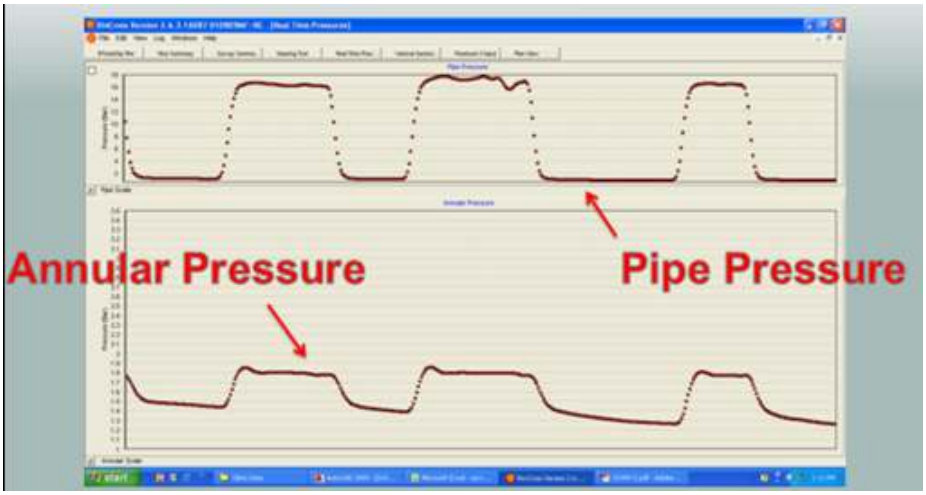
With the Paratrack system, the annular pressure is measured by using a Pressure While Drilling sub (PWD sub) in place of the orienting sub. This sub has two pressure ports filled with grease which allow pressure to be transmitted from the annulus into a pressure port located in the base of the pressure module.



The Pressure While Drilling Sub

There are several advantages of measuring pressure while drilling. The key benefit is the possibility of monitoring hole condition. If the pressures rise higher than a previously calculated maximum pressure then it is an indication that there may be a problem with cuttings buildup or hole collapse.
Even if a pre-project pressure calculation has not been made, it can still be beneficial to use pressure while drilling as a sudden increase in annular pressure can still indicate problems downhole.

Pressure information can be displayed in real time and can also be recorded. It is possible to vary the resolution of the data recorded and this can be set on a time basis (readings per second) and on a pressure change basis (if the pressure rises more than a predetermined amount between measurements an additional recording is made).



Example of realtime Pressure While drilling output

Weight On Bit
This was designed for use on long crossings, especially in soft formation where an approximate the weight on bit cannot be determined by looking at the differential pressure on the motor.

By using an adapted PWD sub with in-built strain gauges the sub is able to measure the weight applied to the bit while drilling. This removes the guesswork with how much push force is lost due to friction on the drillpipe while drilling.

RPM
The Paratrack system also has the capability of RPM determination which can be used alongside annular pressure to continue measuring realtime downhole parameters during reaming and pipe pulling operations.

Gyroscopic Azimuth Verification
This is a new development by Vector magnetics which is due to be released in the near future. This will give a north seeking gyroscopic backup to the magnetic azimuth provided by the steering tool.

Everything you always wanted to know about wire line systems – but were afraid to ask.

Introduction

Good morning ladies and gentlemen, my name is Craig Rowney and I am a manager at Inrock Ltd with responsibilities that include oversight over our pilot hole guidance department.
I would like to thank the DCA in giving Inrock and myself the chance to talk to you all today about wireline guidance systems and in particular Magnetic Wireline guidance systems.
Before I go on, it probably does not go without notice that I am sharing the platform today with Dan Billig of Prime Horizontal. Both of our respective entities are worldwide users and joint distributors of Vector Magnetics LCC ParaTrack™ guidance tooling and services. Therefore in the interest of avoiding content duplication in our presentations, aspects pertaining specifically to the Vector Magnetics ParaTrack™ system will be shared.

Overview of Wireline Guidance systems.

Current wireline guidance systems can be in the main defined into three groups.
• Walkover – Cable systems to extend tracking and power range. As many contractors are already familiar with these systems they will not be covered in our talks today.
• Gyro Tooling –
• Magnetic Wireline Steering tool systems- (MWLST)

MWLST have been for many years the predominant steering tooling in terms of market volume and metres drilled for the larger midi / maxi global rig sector. All magnetic guidance tools utilize magnetometers and accelerometers to calculate a directional heading. These readings are recorded at specific intervals and the data is used to calculate the drill paths location and direction.
Historically in some areas, crossings have be achieved with the calculated data alone, albeit this method is not commonly applied today, as in some locations, usually the more congested areas, magnetic interference can affect the azimuth readings and the calculations. To compensate, an artificial magnetic field source can be placed along the surface to track the bore.

MWLST can in general be in subdivided in either AC either DC based systems , not a reference I might add to “High Voltage Rock’n roll” bands.
Rather it refers to the type of electrical current used to generate artificial magnetic field around a Coil/ Grid laid out on the ground.
Starting in reverse order , based on year of development, first to market were the
DC Based Systems, with an example being the Tru Tracker system developed by tensor back to the 1980’s.
Using DC Current to power surface tracking coils, by means of a DC welding machine commonly found on pipeline sites, these systems propelled the growth of the HDD industry through the late 1980’s up to the final years of the last millennium.
Requiring large DC currents required to generate magnetic fields, Tru Track coils were limited in

width and length and range of depth tracking was restricted to around 40 metres. Recent upgrades have seen a claimed improvement from manufacturers with quoted depth range of 300 metres, using lower current amperage.

ParaTrack™ 2 is the evolution of the DC Surface Wire Tracking System, appearing in the HDD market at the turn of the century. Driven by a small hand-held low AC current power supply, ParaTrack™2 provided superior survey quality in magnetically noisy environments when compared with DC based services. Increased flexibility in coil layouts meant the system has be used in environments and depths which are not achievable by older DC systems.
At the heart of the system lies the ParaTrack™ 2 probe situated within a non magnetic collar and forming part of the Bottom Hole Assembly. The sensor package in the probe acquires toolface , borehole inclination and magnetic data information, which is sent by wireline telemetry to surface for processing and display.
Over the years, ParaTrack™ has developed by Vector Magnetics into a powerful suite of tooling, including the addition of different secondary borehole location methods. Coil configurations may include closed loop tracking, single wire with earth return, or even tracking wire installed in existing bores for precise spacing of multiple bores. Numerous intersect crossings have been achieved using ParaTrack™ by passive or active ranging systems.
Hardware developments include the introduction of The Beacon Tracker System /Large Beacon which enables tracking under obstacles where a conventional wire coil cannot be placed.
Pressure Module (- By means of separate electronics module attached to the probe, providing annular and drill pipe pressure readings and the At Bit Inclination Assembly (ABIA) which provides real-time monitoring of at-bit inclination - an industry first.

So coming back to the title of the speech , what questions might you be “afraid to ask”.
With this in mind, I have attempted to put myself in your position and I highlighted a few general questions below, which you may find of use.

What kind of accuracies should you expect to see when using the ParaTrack™ 2 wireline system?
The quoted accuracy of the ParaTrack™ system in areas of secondary verification is 2% of depth from wire to probe. However in the real world, accuracies of less than 1% have been achieved by means of taking multiple shots which are averaged.
It should be mentioned once more that ParaTrack™ coil shots are independent of the calculated survey data recorded by the ParaTrack™ Probe. Furthermore each P2 measurement is independent of the previous measurement and is relative to the coil or beacon on the survey which is used as a reference.

When are bore hole surveys taken?
There are no restrictions on when a survey or ParaTrack™ / Beacon shot can be taken, which commonly takes around 30 seconds to complete. Generally speaking they are taken at the end of drilling

of the drill pipe. Frequency and intervals can be adjusted and for example increased to take into the needs of the project, i.e. for radius control purposes, gravity sewer bores, or in the case of soft jetting bores, to inhibit the malpractice of “Dolphin Drilling”, much to chagrin of drillers.

Can wireline steering tools assist with bore-hole radius and steering control in Mud Motor Rock Drilling?

Generally speaking all pilot hole rock drilling bottom hole assemblies require the directional sensor package to be placed behind the drill head at a distance much larger than on jetting assemblies. This bit to sensor distance is at its greatest when using mud motors and even more so, when shock tools are also incorporated into the assembly, where distance behind the drill head can reach over upwards of 10 metres. For many years this has presented the perennial problem of how to steer the bore to required tolerances in rock, when the data received at surface at any time is historically drilled bore and not what you are actually drilling at that particular point in time.

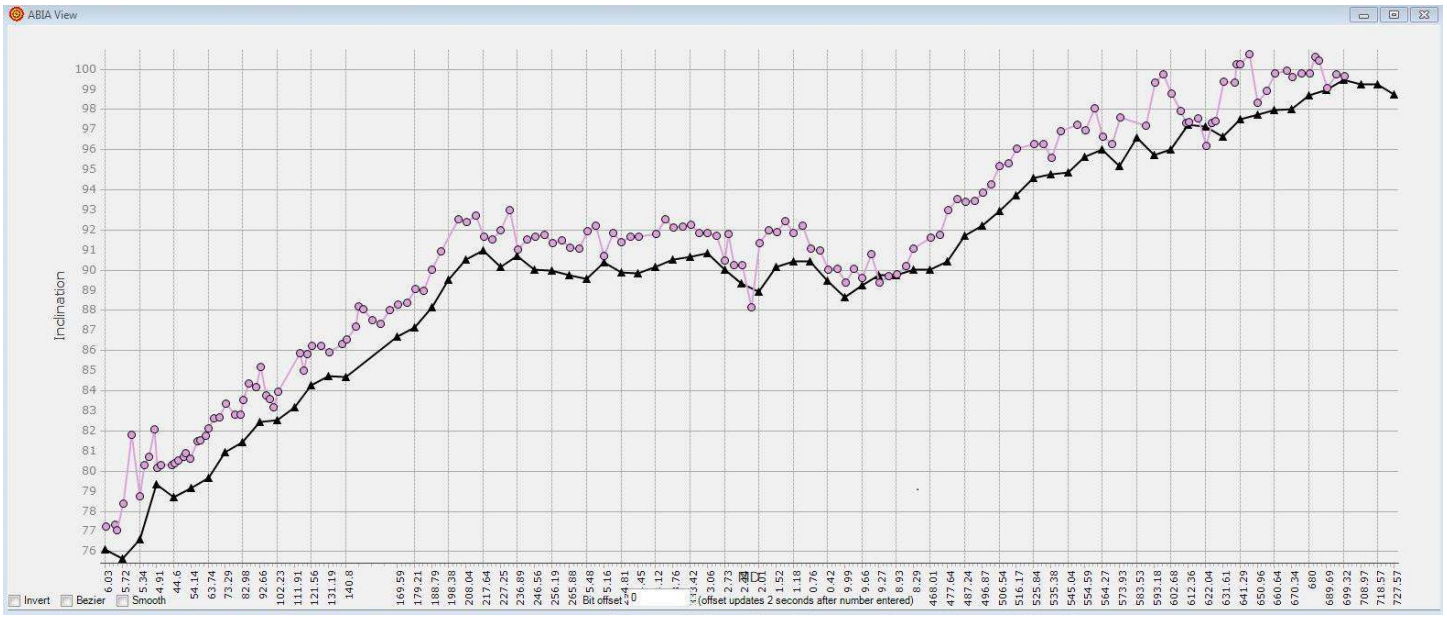
We all know that controlling pilot bore radii is important for product pipe installation and integrity, consequently as minimum radius requirements increase, conversely the room for maneuver in steering decreases. Less well understood is the need to control radii also for hole opener tooling purposes, especially in hard and abrasive rock and the required minimum radius may be greater than that of the product pipe.

The bit to sensor issues on mud motors has represented a technical challenge to the HDD industry for many years. Recently the introduction to the market of the Vector Magnetics At Bit Inclination Acquisition system commonly referred to as “ABIA” has ameliorated to a large extent this problem. With ABIA electronics housed in a sub behind the drill bit, early warnings of an inadvertent change in bore-hole inclination can now be achieved. Communication to surface of the real time inclination data is transmitted by a wireless method to the ParaTrack™ probe situated in its normal position behind the motor, then onwards to surface by wireline telemetry.

An example of where ABIA technology has been used to great effect, occurred on a challenging hard rock crossing in Langogne in Southern France. Very early on in the planning stages it was known that the HDD profile would pass through geological hazards including most noticeably two fault zones and sub vertical inclined strata of varying RQD. Added to this the compound radius and minimum radius requirements for the product pipe only served to increase the complexity of the pilot bore and the demands on the guidance engineer. An assumption was made that the chances of deflection of the pilot bore path was going to be high due to the nature of the geology, therefore means for an early detection and minimisation of angular “dog legs” was paramount for the success of the project.

Referring to the summary graph that highlights inclination readings measured by the ABIA sensor and those from the ParaTrack™ probe situated in the Non Magnetic Collar. You can see that there is trend lines for both data sets that correlate for the most part well. I should point out at this stage that the difference in absolute inclination readings is due to the ABIA sensor being situated in the “bent” portion of the Mud Motor and not being in the axis of the bore, like the ParaTrack™ probe. As this angular offset was mostly constant throughout the bore a high degree of certainty was given to the real-time ABIA inclination readings, allowing the bore to be steered by the ABIA tool. In summary as antici-

pated plotting a course through the fault zone was challenging and not without issues even with the ABIA system. However the guidance engineer and client saw great value in not having to resort to the old fashioned method of “pattern” steering in rapidly changing rock strata with its inherent bit to sensor data lag. The ABIA system resulted in reducing instances of dog legs, which was of benefit to the subsequent rock reaming stages of the project. It is our considered opinion that the ABIA technology in a world of ever tighter specifications represents an opportunity in raising the bar of HDD pilot bore standards in rock.



On a side note, the development of the ABIA has generated other unforeseen benefits. As mentioned above the ABIA sensor works by wireless transmission hence is its possible use as active signal for Magnetic Ranging purposes. An example being a meet-in-the middle intersect crossing, where early detection of the relative location of the target and active bores is an advantage.

Can the ParaTrack™ be used with Air Hammers?

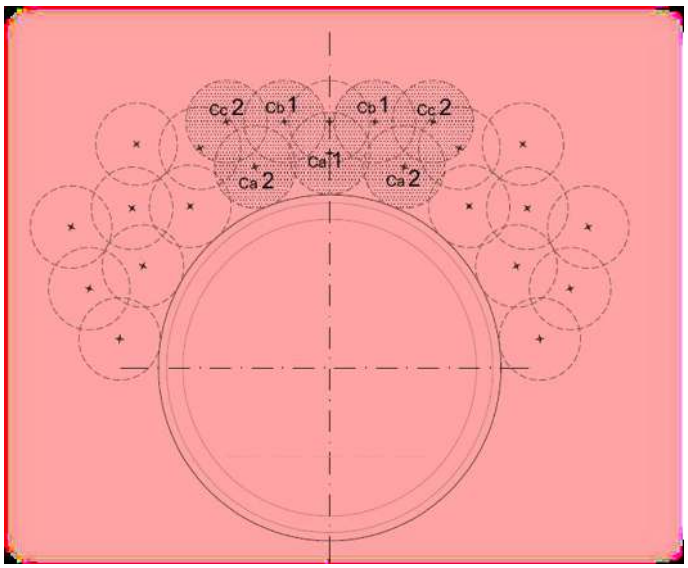
Yes and No. This depends on the type of air hammer being used in tandem with the ParaTrack™ probe downhole. Excessive vibration resulting from Air Hammer operations have and can lead to damage of most wireline systems, most noticeably gyros and magnetic wireline steering tools, with their relatively sensitive electronics.

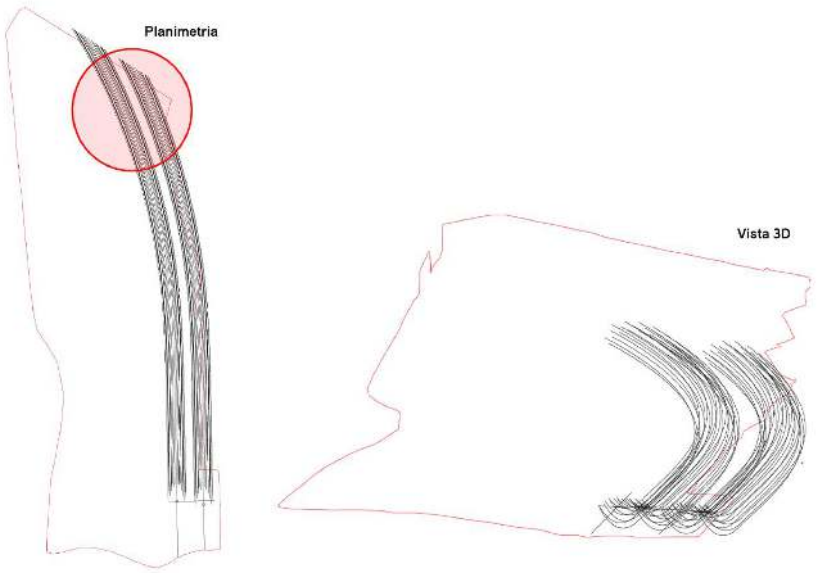
However successful field trials and commercial crossings completed to date, have shown that the ParaTrack™ 2 probe can work downhole with Inrock XTH Hammer system, opening up additional operational avenues for the HDD Hammer and overcoming limitations imposed by the use of Walkover survey tooling . Intrinsic to the design of these hammers was a need to minimize excessive axial vibrations common to other hammers, without impairing drilling productivity. This has been achieved and four recent bores have been completed to date in North America.

2 x 5” OD Hammer /Paratrack™ probe Assembly
Example #1 - 457m Location: Chicago, IL Rock Type: Limestone
Example #2 155m Location: Pittsburgh, PA, Rock Type: Medium formation
Example #3 -243m in Karstic Limestone Average rate of penetration 25 mins / joint

All completed with ruggedized (strengthened ParaTrack™ probes)
Evaluation continues with a view to finding probe vibrational limits in even harder rock

What other Civil Engineering applications are Wireline steering tools used for?
Inrock have been involved in a number of Civil Engineering projects other than pipeline HDD, which required the use of ParaTrack™ Wireline Steering tools.
An example being the a Metro line TBM ground stabilisation Warsaw, Poland
Multiple bores were drilled using a ParaTrack™ surface coils for the purpose of installing, Tube a Manchette piping and pre-treatment of the ground by grouting methods. This required highly accura-testeering of multiple parallel bores in close proximity to each other, in order to allow subsequent overlap of grouted treatment areas.
Whilst the principle of pre-treatment injection grouting through multiple bores is not uncommon in the Tunnelling world., this particular this project has the unique added challenge of a compound curve bore profile, starting from a surface launch down to a predetermined depth above the future path of TBM Bore. In light of this the main contractor employed HDD Rig technology and HDD Wireline Steering tool methods, in order to drill the bores. Directional control was made by the use of a ParaTrack Coil on surface, with the option of using Passive Magnetic ranging as a fall back.





Magnetic wireline systems take time to set up, which is not required with other systems?
Yes it is certainly true that Inrock guidance engineers would land survey the entire crossing entry to exit, as part of their standard HDD ParaTrack™ guidance works.
However rather seeing this as a negative and additional costs, it should be viewed as an additional check and due diligence on pilot bore profile planning.
To quote the famous German General Helmuth von Moltke the Elder " No plan of operations extends with and certainty beyond the first contact with the main hostile force".
This is often quote the case with HDD crossings and bore profile plans in general, even those which have been given great forethought.
Consequently during the setting out of the ParaTrack™ coils, unforeseen profile issues and or obstacles have been noted, which were not at the time of project planning . In certain instances this has led minor adjustments of rig / rig entry, way and exit points or the complete on site redesign of the HDD Crossing. Whilst never welcome, redesign of pilot bore profiles are best known about prior to the start of drilling works. As a rule of thumb the set up time for ParaTrack™ as a percentage of the whole crossing is at its highest for a jetting crossing and much lower for a rock crossing. I.e. the time spent land surveying and setting out the wireline grids is minimal for a rock crossing compared with the time to physically drill the bores is much greater.

Must all tracking ParaTrack™ coils be exactly centred over the line of drilling?
Whilst it is preferable to place one side of the tracking coils over the centreline of a bore , this is not always a feasible option. ParaTrack™ allows for offset coils away from the drill line and various shape configurations, which were not feasible on older DC systems.
It is worth noting that a percentage of bores are completed without resorting to ParaTrack™ coils at all and are solely by Beacon Solenoid Systems. Most noticeably this occurs in Australia with their reduced set up times.

Do you always need to run a wire down the drill pipe to power the probe?

For the purposes of the ParaTrack™ steering tool and most wireline steering to the answer is yes.

Having personally ran a number of Mud Pulse Measurement While Drilling systems in my oilfield days and having tested wireless signal transmission on HDD crossings ; is not necessarily a case that the “grass is greener on the other side”. Wireless transmission can lead to the introduction of interference on telemetry leading to loss of signal. Therefore the consensus remains that the drill wire to the probe, remains an efficient and relatively quick method of powering down hole electronics and a convenient conduit for high data rate telemetry.

If there are separate benefits to Gyro and Magnetic Wireline steering tooling, why not combine them into one tool package?

Certainly at Vector Magnetics and Inrock we recognised that there a synergies between the two different survey technologies, which when combined would complement each other.

Consequently Inrock have been working in partnership with Vector magnetics to develop such a ParaTrack™ Gyro tool and presently we are in the final evaluation stages of testing , having completed a number of bores in Canada.

A brief synopsis on the tool concept of the system is as follows.

From the outset the design concept was one of the use of Optical Gyro sensors working as survey tool in tandem ParaTrack™ probe and to create a modular tool architecture.

That the field engineer would have the choice of making an Optical gyro shot in addition to all the other choices available with a ParaTrack™ 2.

That the Gyro/ ParaTrack™ 2 survey shots would be taken as normal at the end of the drilled joint, or more frequently as and when required.

That the Gyro system would form part of the Vector Magnetics’ RivCross® suite of software, then theoretically up to THREE INDEPENDENT surveys could taken at one borehole location using the combination of the Optical Gyro survey tool and the ParaTrack™ Steering tool.

Actually it could be four survey data shots, if ABIA Smart Mud Motor technology is utilised at the same time.

With this arsenal of survey choices at his disposal, the guidance engineer can choose which survey method to use at any particular location, depending on the needs of the crossing at that particular juncture of the bore.

An example of a Gyro data is shown on the enclosed slide.

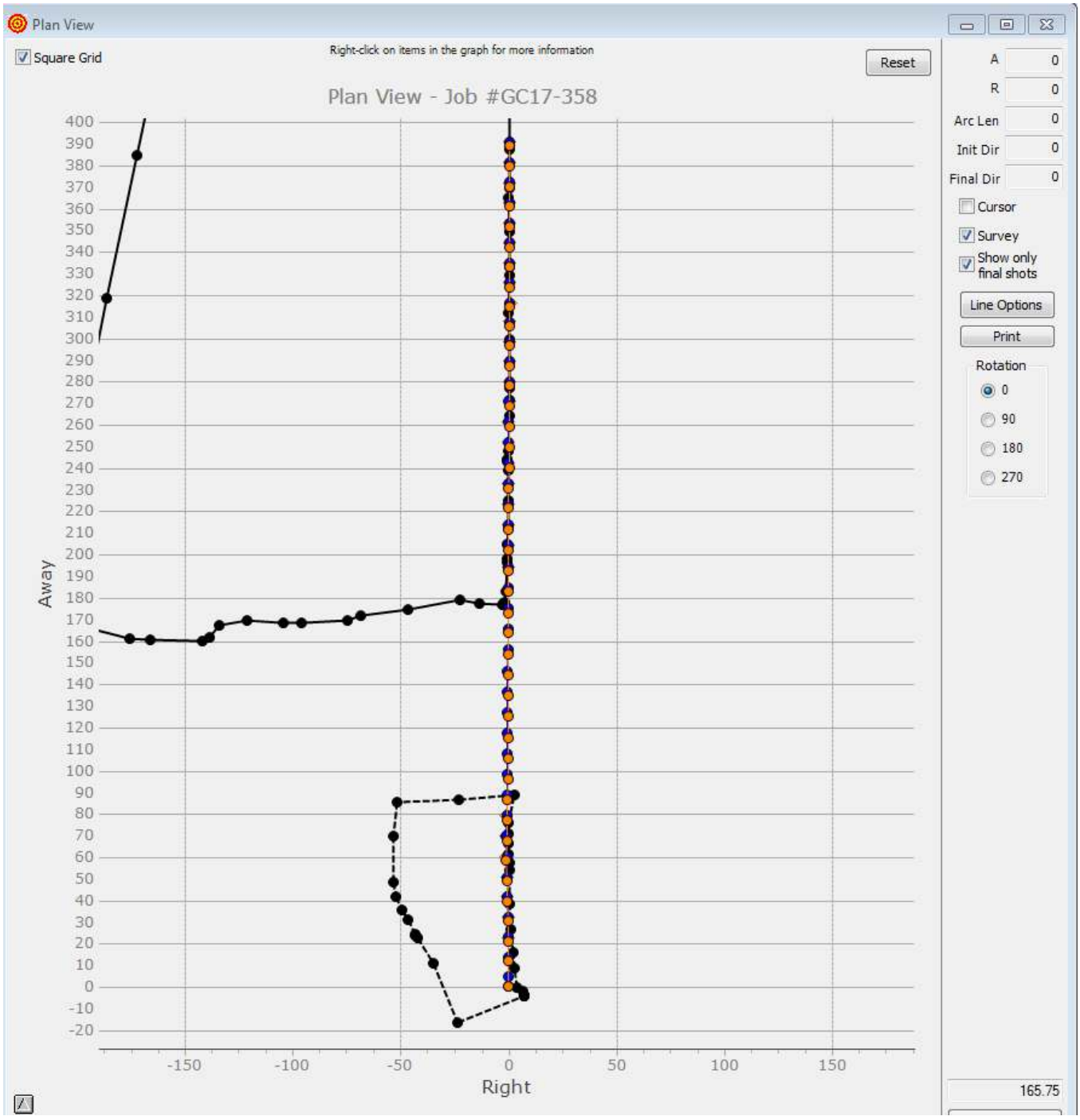
Project Owner: xxxxxx
Location: Calgary, AB
Client: xxxxxxx
Crossing: Bow River
Length: 504m
Product: 20inch Steel
Design Radius: 400m
Formation: Unconsolidated. Sand, Fractured Sandstone, Hard Sandstone, Gravel, Clay
Guidance Tooling Used: P2, Gyro, Pressure, BTS
Drilling Tooling BHA: 7” OD Inrock XTM Mud Motor, 6-3/4” NMDC.
Survey Procedure: ABIA->P2->Gyro.

Two large ParaTrack™ surface coils were set out in advance of drilling as the default survey verification method. Shots taken using the ParaTrack™ 2 Coil and calculated surveys were the primary method of surveying on this bore and marked as blue dots.
Turning now our attention to the Gyro tooling.

Prior to the start of drilling a directional baseline for the Gyro surveys was calculated using Latitude and Longitude supplied by the client and this value was cross checked using data received from the ParaTrack™ surface coils. The decision was made to take a Gyro surveys at the same time as a ParaTrack™ 2 shot for complete evaluation purposes and as can be seen by the Orange dots, the Gyro shots matching up sympathetically with those surveys taken by ParaTrack™ 2 , which is the ideal surveying scenario.

As Magnetic Wireline Steering tool engineers and HDD contractors familiar with ParaTrack™ might appreciate, this was not the most challenging bore from a surveying standpoint and we would no doubt reach agreement that the bore could be steered by standard ParaTrack™ methods. However this was not the purpose of the evaluation, which was to prove our the overall concept of the ParaTrack ™ Gyro system.

Interestingly the client was as equally impressed with the information received from the ABIA tool, as considering how unpredictable the formation was, they managed to control in real time bore-hole radius specifications.



It is worth pointing out that on this particular bore that there was no cause to use Shock Sub tooling with the Mud Motors and the Vector Gyro. Thereby reducing drilling tooling costs and from a steering aspect, minimising critical bit to sensor distances.

It is our considered opinion that a rock drilling assembly consisting of Smart “ABIA” mud motors, combined with Gyro/ParaTrack™ technology will enhance HDD rock drilling pilot bore works.

What is the future going to be of Wireline Steering tools?

Looking to the future, it is envisaged that Magnetic wireline steering techniques in combination with Gyros will continue to diversify and multiply in type numbers, leading to further fragmentation of the wire line steering tool market. This can only be of benefit to HDD contractors as it should provide increased vendor choice and reduced Gyro tool, in a sector of the market that has long been void of competition.

A study of the ParaTrack™ market has thrown up the interesting fact, that as a percentage of the bore length drilled, 75% is surveyed by a ParaTrack™ coil method. With this in mind a further advancement of ABIA technology is underway, which takes advantage of the fact the ParaTrack™ coil can be used to work out an azimuth bearings readings that are independent of interference etc and ultimately this means we are working to provide real-time “At -bit” readings in the horizontal plane.

Ultimately which wireline system should we use for our project?

In a perfect world, there is no such thing as default wireline system of choice for a HDD Crossing. Each crossing should be assessed on its own individual requirements, with subsequent decisions made according to the technical and commercial needs of the crossing.

Alas reality is somewhat different. HDD contractors live in the world of competitive lump sum bids, possible over reach on engineering specifications and the day to day commercial relationships with vendors, all of which gets thrown into the mix, when deciding on steering tool choices.

In most cases, multiple technical solutions can be used to successfully complete any given project and it is rare occurrence when only one technological solution can be utilized, something to bear in mind when planning your next HDD project.

I trust you will have found the talk on wireline steering tools informative and it goes without saying that I appreciate your attention.

Dan and I would be happy to try and answer any questions that you may have regarding wireline systems and ParaTrack™ in particular.

Contractual Risk Management of HDD Projects

Introduction

My name is Kevin Mullins. I am a Barrister-at-Law who has specialised in international engineering and construction law for over 30 years and over the past 15 years I have developed a modest expertise in the contract management of oil and gas pipeline projects and related HDD projects.

This morning, at the kind invitation of the DCA Board, I come to speak to you on the subject of the Contractual Risk Management of HDD Projects. I have no doubt, that as HDD contractors, this is a subject which requires your attention, as you endeavour to execute and complete HDD projects on a successful basis, not only successful in terms of technical and operational considerations, but also successful in terms of the bottom line. By this I mean, in terms of achieving a profit margin at the completion of the project, which is broadly similar to the profit margin you contemplated when you were formulating your proposal to the client at the conceptional and tender stage of the project.

Subject Matter

Let me begin by describing exactly what is meant by "the management of contractual risk". "Risk" is defined in the Oxford English Dictionary as "a possibility involving exposure to danger or to loss". In the world of HDD projects there are two types of Risk, being, Operational Risk and Contractual Risk.

An "operational risk", in an HDD context, can be defined as a risk item related to the action of a contracting party, or to any circumstance, which has the potential to cause disruption to the planned progress of the works resulting in additional costs being incurred in the execution of the project.

A "Contractual Risk", in an HDD context, can be defined as a risk related to a contractual provision, or a contractual structure, which has the potential to expose a contracting party to the possibility of liability or loss, in the event of an operational risk item materialising.

The "Management of Contractual Risk", can therefore be described as, negotiating or applying contractual provisions, which are designed to ensure, with as much certainty as is reasonably possible, that a party's exposure to the possibility of liability or loss, in the event of an operational risk item materialising, is minimised or nullified.

Contractual Structures

Turning now to the question of the various contractual structures which are available in relation to HDD projects.

By its very nature, an HDD project is rarely a complete and self-contained project in its own right but instead, the HDD scope usually forms a discrete part of a larger scope, such as, for example, the limited scope of crossing a specific river or other obstacle in the path of the overall scope of a long-distance pipeline.

The HDD scope may be let by the client direct to the HDD contractor, making the HDD contractor a main-contractor for that particular scope or, as is very much more often the case, the overall scope, including the crossing, is let by the client to a main-contractor, who then subcontracts the HDD scope to the HDD contractor.

Whatever the contractual structure may be, it is most often true to say that the HDD crossing is that part of the overall scope which offers the highest relative level of possibility of an operational risk item materialising, meaning, the highest level of possibility that something will go wrong and thereby cause disruption to the progress of the overall works, resulting in additional costs being incurred as a consequence.

It is important to realize that, in addition to having the highest risk of failure of all activities on a project, the HDD scope may very well be on the critical path of the overall project, with the result that disruption on the HDD scope may cause disruption to the entire project, with financial consequences out of all proportion to the contract price of the HDD scope.

In a perfect world, the risks inherent in executing a pipeline project, including HDD crossings, would remain with the client, meaning, that if disruption due to unforeseen circumstances occurs, for which the contractor is not responsible, resulting in additional costs being incurred, the burden of meeting those additional costs would fall on the client and not on the contractor.

In the real world, however, it is a sad fact that, from the point of view of the client, the purpose of the HDD contract is, not only to document the obligations of the HDD contractor, but also, in particular, it is an excellent opportunity for the client to transfer on to the shoulders of the HDD contractor as much risk as possible, so that in the event that disruption occurs, resulting in additional costs, the burden of meeting those additional costs will fall on the HDD contractor rather than on the client.

Contractual Risks

Since the first such project was executed back in the 1970's, HDD has become a globally utilised trenchless technology for the installation of buried infrastructure. Today, all over the world, HDD contractors are involved in the installation of fibre optic networks, electrical connections, cable TV networks, oil and gas pipelines, water and sewage utilities. The benefits of little or no excavation are obvious in minimising surface disruptions, which may be essential in ecologically sensitive areas or high density residential and industrial locations but not all such projects are suitable for the application of HDD techniques.

Therefore, at the initial conceptional engineering stage, the client, or the engineering consultant on behalf of the client, must carefully examine the characteristics of each crossing to evaluate the suitability of HDD as the preferred means of executing a crossing.

An integral part of this conceptional evaluation is a risk assessment to reveal the level of potential operational risk involved in executing the crossing. Most operational risk factors relative to executing

an HDD crossing, such as, for example, the risk of difficulty with site accessibility, the need for temporary rights-of-way, the availability or otherwise of off-site accommodation or storage facilities, complications related to the use of public roads or footpaths, risks related to equipment and personnel, the availability of electricity, water and gas, payment risks, insurance risks, risks related to guarantees, all of these risk factors are common to all projects, be they structural, civil, mechanical, electrical or process engineering projects.

However, all these operational risk factors, and other similar factors, can be assessed and quantified, with a high degree of certainty, so that it is relatively easy to evaluate the consequent disruption if one of these risks materialises and to devise contingencies against such consequences by way of an increased risk margin in the contract price or by devising alternative stand-by operating methods.

Subsurface Conditions

However, there is one risk factor, a risk which outshines all other risk factors in the context of an HDD project, and which cannot be assessed and quantified with a high degree of certainty, and which can be catastrophic in its disruptive effect, and that is the risk related to subsurface conditions.

What is meant by this is the risk that the subsurface formations encountered as the drilling proceeds, the substrata composition, may be different from the conditions and composition indicated by the geotechnical report upon which the HDD contractor has planned the drilling operation.

The first indication an HDD contractor may receive, that things do not seem to be going according to plan, is when he discovers that the drill bit assembly has, for some unknown reason, been deflected from the design trajectory, or he observes a partial or total loss of mud returns, due to its escape along some unknown fissure or other unknown anomaly in the subsurface conditions, resulting in possible damage to the drill bit assembly or to the environment and the drilling coming to a halt or having to be redesigned and redone.

Obviously, at the engineering stage, a determination is made by the client, or on behalf of the client, as to whether an HDD option is geotechnically feasible, by studying existing geological data available for the area and conducting field investigations, including borehole surveys, to identify and assess the subsurface conditions and characteristics likely to be encountered during the drilling.

The crucial point here is that subsurface conditions are generally not homogeneous and, for this reason, the geotechnical report emanating from the geotechnical investigation, no matter how carefully prepared, always falls short of providing absolute certainty as to the geotechnical conditions to be expected.

Having said that, the borehole survey provides the best means of obtaining information on the subsurface soils and bedrock to be encountered along the drill path. These surveys allow for the deve-

lopment of a subsurface geological picture which will be indicative of the distribution of overburden and bedrock materials which the HDD contractor can expect will be encountered along the proposed HDD alignment, but, as I say, the geological picture developed will be indicative only.

The only way to achieve absolutely certainty would be to drill a series of investigative boreholes, in close proximity to eachother, along the centre of the proposed drill path, but this would itself create the precise hazard that the survey is intended to identify by raising the possibility of a later escape of mud returns through the boreholes as the drilling proceeds.

It is, of course, possible to increase the reliability of the borehole survey data by the employment of supplementary investigative techniques such as seismic surveys, ground penetrating radar or electromagnetic surveys, but these geophysical surveys do not produce any certainty as to the exact geological conditions which will be encountered at any particular point along the drill path. In view of all of this, it is essential to ensure, when negotiating the HDD contract, that all risk related to subsurface conditions remains clearly within the scope of the client.

Geotechnical Reports

So far as subsurface conditions are concerned, the HDD contractor should be entitled to rely exclusively upon the geotechnical report and other relevant documentation made available to him by the client and should have no obligation whatever to check on its reliability or accuracy.

The only obligation which the contractor should accept in relation to subsurface conditions is the obligation to ensure that the assumptions which he makes, on the basis of the geotechnical documentation supplied by the client, are logical and reasonable.

In other words, even if the HDD contractor makes an assumption which turns out to be completely wrong, so long as that assumption was logical and reasonable in relation to the geotechnical data supplied by the client, then the contractor should not be answerable to the client for any disruption which occurs as a consequence, and should, in fact, be entitled to an extension of time, if required, and to the reimbursement of additional costs, if any.

For example, if a series of boreholes running along the left of the drill path indicates a continuous stratum of cohesive clay soils, and a similar series of boreholes running along the right of the drill path indicates a similar stratum of cohesive clay soils, then it is logical and reasonable for the HDD contractor to assume that cohesive clay soils will also be encountered along the drill path. However, if this assumption turns out to be wrong, and the HDD contractor encounters unexpected geotechnical conditions which disrupt the progress of the works or precludes the successful completion of the drilling, then, it is the client who is responsible for any time and cost overruns and it is the HDD contractor who must be compensated.

Turn-Key Contracts

However, it is normal in design and build contracts, so called turn-key contracts, to see clauses which provide that the contractor is responsible for obtaining all necessary information, including information on sub-surface geological and hydrological conditions, so as to familiarise himself with all risks, contingencies and other circumstances which may affect the works. The standard turn-key conditions normally provide that the client must make available to the Contractor all relevant data in the client's possession on sub-surface and hydrological conditions at the site, including environmental aspects, but that the contractor shall be responsible for interpreting all such data.

The standard turn-key conditions also usually provide that the contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the works.

Also, the conditions usually provide that contractor shall be deemed to have inspected and examined the site, its surroundings, and all other available information, and to have been satisfied himself as to the sub-surface conditions, the hydrological and the climatic conditions.

All of this may be may be generally acceptable for most turn-key projects, such as building projects, or most civil projects, or process facility projects, where the sub-surface geological conditions can be identified with relative ease, and the substantial objective of the project relates to a facility which is on or above ground. However, such clauses are not acceptable for HDD projects where the sub-surface geological conditions cannot be identified with relative ease, and definitely cannot be identified with any certainty, and the substantial objective of the project relates to a facility which is almost completely underground.

So, the principle is that the HDD contractor should accept no liability whatever for subsurface conditions beyond a liability for ensuring that any conclusions which he forms, from a study of the geotechnical report supplied by the client, as to what subsurface conditions can be expected, are logical and reasonable.

In view of all of the above, it is in the interests of the client to provide as much information as possible to the HDD contractor, relating to subsurface conditions and other geotechnical aspects, to facilitate the preparation of an accurate and comprehensive proposal by the contractor, so that the project, once awarded, can be executed as planned with little or no dispute.

Contract Types

As I said earlier, the HDD scope may be let by the client direct to the HDD contractor, making the HDD contractor a main-contractor for that particular scope but, very much more often, the overall scope, including the crossing, is let by the client to a main-contractor, who then subcontracts the HDD scope to the HDD subcontractor.

A variety of general types of contracts are available to the client when deciding upon what type of contractual structure will best suit him from the point of view of price and risk.

Generally speaking, the types of contract available are unit price contracts, daily rate contracts, cost plus contracts, target price contracts, and lump sum contracts, with lump sum contracts being by far the most common as the lump sum contracts offers the client the greatest possibilities for passing the greatest amount of risk on to the contractor.

Back-to-Back Subcontracts

When subletting the HDD scope to the HDD subcontractor, the main contractor frequently structures the subcontract as a, so called, back-to-back subcontract, meaning, that the provisions which are to apply to the HDD subcontract in relation to the HDD scope are exactly the same as the provisions which apply to the main contract in relation to the main contract scope.

There is nothing wrong with such an arrangement insofar as this can be a quick and convenient way of setting up an HDD subcontract. However, there are four aspects of the back-to-back arrangement which must be given particular attention.

First of all, it is not unusual for a main contractor to take on liability for subsurface conditions in relation to the main contract scope but then, unless the back-to-back subcontract is specifically qualified, the liability for subsurface conditions in relation to the HDD subcontract scope will automatically be passed down to the HDD subcontractor under a back-to-back arrangement, without the subsurface conditions ever being specifically mentioned: it is therefore necessary to ensure that the back-to-back arrangement is specifically qualified to exclude such liability.

Secondly, it is very common for a back-to-back subcontract to provide that the main contractor shall have no liability to the HDD subcontractor for any claim which the HDD subcontractor may bring against the main contractor unless the main contractor can pass on that liability to the client in terms of the main contract: the back-to-back HDD subcontract should be specifically qualified to ensure that a valid claim brought by the HDD subcontractor under the provisions of the HDD subcontract must be met by the main contractor regardless of whether the main contractor can pursue the same claim against the client under the provisions of the main contract.

Thirdly, various provisions in both the main contract and the HDD subcontract might have a reference to percentages such as, for example, a 10% cap on penalties for delay or a 20% overall cap on liability; when entering into a back-to-back subcontract it is vital to ensure that it is clear that the percentages referred to in the HDD subcontract relate to the subcontract price and not the main contract price.

This element can often lead to difficulties in negotiations because, for example, if there is a 10% cap on delay penalties in the subcontract in relation to delays for which the subcontractor is wholly responsible, this same delay may cause a knock-on delay to the main contract for which the main con-

tractor may have a liability of, say, ten times that amount, being, 10% of the main contract price.

In other words, for example, the main contractor may be liable to the client for 100.000€ but only be able to recover 10.000€ from the subcontractor, as a result of a delay for which the subcontractor bears total responsibility: the main contractor is therefore exposed to a liability of 90.000€ in relation to a default for which he is not in any way responsible.

However, no matter what the consequence may be for the main contractor, it must always be clear that percentage caps on liability under the terms of the HDD subcontract relate to the percentages of the subcontract contract price and not to the main contract price.

Fourthly, the payment terms in the main contract may be may be as mush as 90 days from receipt of invoice, which may be acceptable in a project of, say, two years duration but this would not be acceptable in an HDD project of, say, two months duration.

Separate payment terms must therefore be negotiated, on a stand alone basis, in a back-to-back subcontract, so that the negative cash flow is reduced to a minimum.

Claims

Turning now to the question of claims by which we mean that there has been some disruption to the planned progress of the works, resulting in additional or alternative operating resources or execution methods being required, and perhaps a prolongation of the project programme.

As a result, additional costs have been incurred, in relation to which the party who incurred the additional costs now wishes to recover those costs from the other party.

The fundamental principal here is that “a claim is only as good as the evidence available to support it”. In other words, it is not good enough for the HDD contractor simply to say that he, the contractor, is not responsible for the fact that the additional costs were incurred and that therefore the client should bear these costs.

Except in very exceptional circumstances, one or other of the two parties, the client or the HDD contractor, must bear the additional costs. In the very exceptional circumstances to which I refer, the burden of meeting the additional costs is split in varying proportions between the parties.

As it is the contractor who actually incurs the additional costs in the first place, or the client retains an amount equal to the additional costs from payments which he would otherwise have made to the HDD contractor, it is nearly always the HDD contractor who is the claimant and the client is nearly always the respondent.

This is very important because, in the first instance, it is the claimant who bears the burden of proof

and not the respondent: in other words, it is up to the contractor to prove that the client is contractually bound to reimburse the contractor for the additional costs which the contractor has incurred and, conversely, there is no requirement for the client to prove why he should not reimburse the contractor.

The level of proof required is that of at least a 51% probability: in other words, the matter is decided according to the balance of probability.

Proof of Responsibility

As I said above, the first indication an HDD contractor may receive that something is wrong, is when he discovers that the drill bit assembly has been deflected from the design trajectory or he observes a partial or total loss of mud returns.

The cause of this misfortune may not be immediately obvious and indeed it may remain a mystery forever due to the fact that a visual inspection is not possible in the context of an HDD project.

There are many reasons why an HDD contractor may be at fault when a drilling failure occurs but the most typical of these is where there has been a lack of proper professionalism in the drilling design, or unqualified operational personal have been deployed on the operations, or the capacity of the equipment is inadequate in relation to the scale of the project.

However, more often than not, the most obvious cause of the disruption is to be found in some discrepancy between the sub-surface geological conditions indicated in the geotechnical report and the subsurface geological conditions actually encountered as the drilling progressed.

The problem, of course, is that it may be impossible to prove, on the balance of probabilities, what the cause actually was and therefore, unless there is a specific provision in the contract dealing with this point, it may be impossible to establish that the HDD contractor is entitled to reimbursement of additional costs and an extension of time if required.

The contractual position of the HDD contractor is made worse by the fact that the required reaction of the HDD contractor when such disruption is encountered is to do whatever is reasonably necessary to complete the drilling, perhaps to redrill a major section of the drilling along a revised trajectory, all at a time before there has been any acceptance by the client that the HDD contractor is entitled to be compensated by the client for the time and cost involved.

So, as usual, it is the HDD contractor who must initially incur the costs and be open to liability for delay, and thereby becomes the claimant, while the client is the respondent who has no obligation to grant an extension of time, or to compensate the HDD contractor for the additional costs incurred, unless the HDD contractor can prove, on the balance of probabilities, that the cause of the disruption is a client risk item: this he may be unable to do because the cause of the disruption may not be known with any certainty at the time that the claim is being submitted and, indeed, the cause may never be known.

In view of all of this, the HDD contract should contain a provision which creates an assumption that unforeseen subsurface conditions incompatible with the subsurface conditions indicated in the geotechnical data are responsible for the disruption. Specifically, in the event of disruption occurring at some point along the drill path, in circumstances where the cause of the disruption is unknown, but where the most probable cause is that unforeseen subsurface conditions have been encountered, which are incompatible with the subsurface conditions indicated in the geotechnical report issued by the client and upon which the drilling design is based, the HDD contract should create the initial assumption that this is actually the cause and thereby place the burden of proof on the client to prove, if he wished to do so, that this is not so.

Progress Reports

As I said earlier, “a claim is only as good as the evidence available to support it” and therefore it is of vital importance for the contractor to ensure that he always has sufficient evidence available to him which he can produce and rely on in the event that a claim situation arises. In this regard, the most important evidence is the evidence of what actually happened to bring about the claim situation, and therefore the best evidence is the evidence contained in the hourly and daily operating data reports and the daily, weekly or monthly reports to the client.

These reporting documents, progress reports, should be prepared in such detail and with such care so that that it is possible to reconstruct the progress of the drilling from the progress reports, minute by minute, without having to obtain explanations or comments from project management or site management or anyone else.

When these progress reports are delivered to the client, they should be signed off by the client evidencing the fact that the documents have been delivered to the client. It is not necessary for the client to indicate whether or not he agrees with the contents of the documents, only that he has received them.

The progress reports to the client should contain a full account of all drilling activity including, in particular, if anything is not going according to plan, the HDD contractor’s version of everything that happens and his view of the cause of what happened. If the client disagrees with anything contained in the progress reports, this fact should be recorded separately, but the reports themselves should not be amended.

Disputes

In the event of a dispute developing between the client and the contractor, it is normal in standard construction contracts to have varying degrees of dispute resolution structures available, increasing in procedural formality, such as, first of all, negotiation in good faith; then, nonbinding mediation through a third party; then, binding arbitration; and, finally, litigation through the courts.

My own view on these options is that if you ever have to go to arbitration or litigation through the courts, you have a major problem on your hands.

Arbitration is supposed to be a relatively quick, uncomplicated and inexpensive process when compared to litigation through the courts but, in my experience, arbitration can take a very long time, can be very complicated and can cost a fortune.

Arbitration may be a suitable way forward where the amount in dispute runs to tens of millions of Euro but in the context of the average HDD contract, where the amount in dispute will rarely exceed a few hundred thousand Euro, the time and effort and expense of arbitration is simply not worth the risk. Litigation through the courts can be nearly as bad and can be even worse in some jurisdictions.

My preference in this matter if for a single mediator who, if his mediation is unsuccessful, has the authority to come to a decision which will be binding on both parties, with all submissions to be in the form of documentary evidence, in other words, in writing.

The presence of an arbitration clause in an HDD contract can also, on occasions, be a hindrance rather than a help to an HDD contractor. This is because the presence of an arbitration clause raises the possibility that a client will threaten to refer a matter to arbitration rather than come to a speedy agreement, in the confident knowledge that the HDD contractor will compromise his claim rather than submit to the time and cost involved in arbitration proceedings.

Conclusion

In conclusion, as I said at the beginning of this talk, the “Management of Contractual Risk” can be described as giving effect to a contract in such a way that a party’s exposure to liability or loss, is minimised or nullified. It has to be remembered that it is always the clients intention that as much risk as possible be placed on the shoulders of the contractor, so that he, the client, can rid himself of such risk and the liability which goes with such risk.

As I said earlier, the object of the HDD project from the contractor’s point of view is not only to execute the crossing successfully from the technical and operational point of view, but also in terms of achieving the intended profit margin.

In summary it can be said that to reach these goals, it is necessary first of all to secure a contract with acceptable terms and conditions and then to devise a technically sound operating plan and then to agree a satisfactory contract price and then to execute the project to the highest technical and operational standards, and finally it is an excellent strategy to have a reliable and experienced construction contract manager at your side at all times throughout the whole process.

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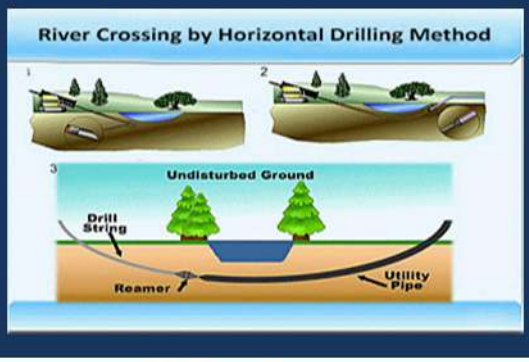
Management of Contractual Risk



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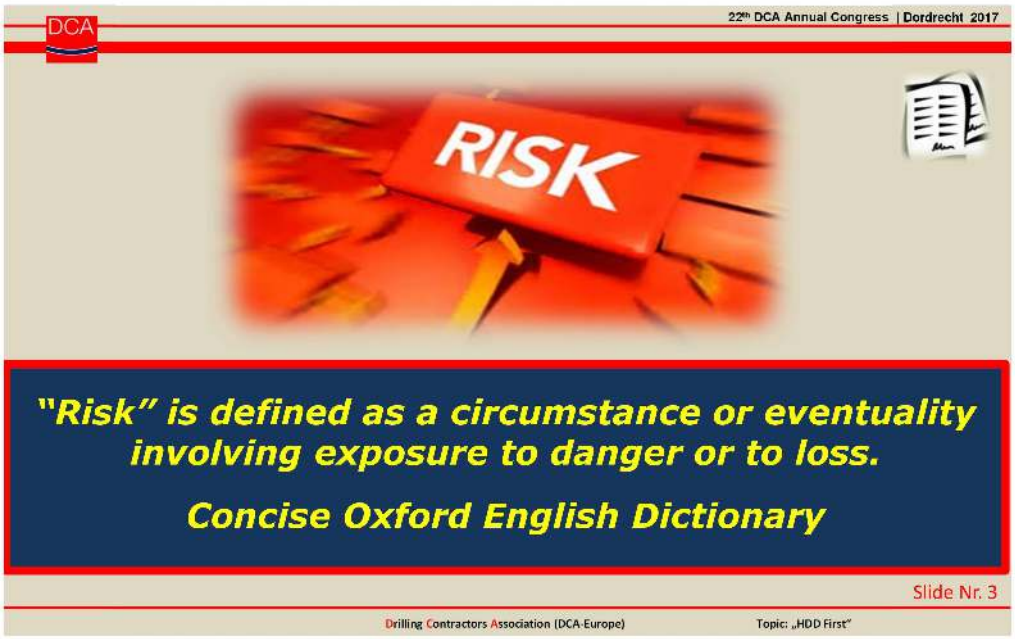
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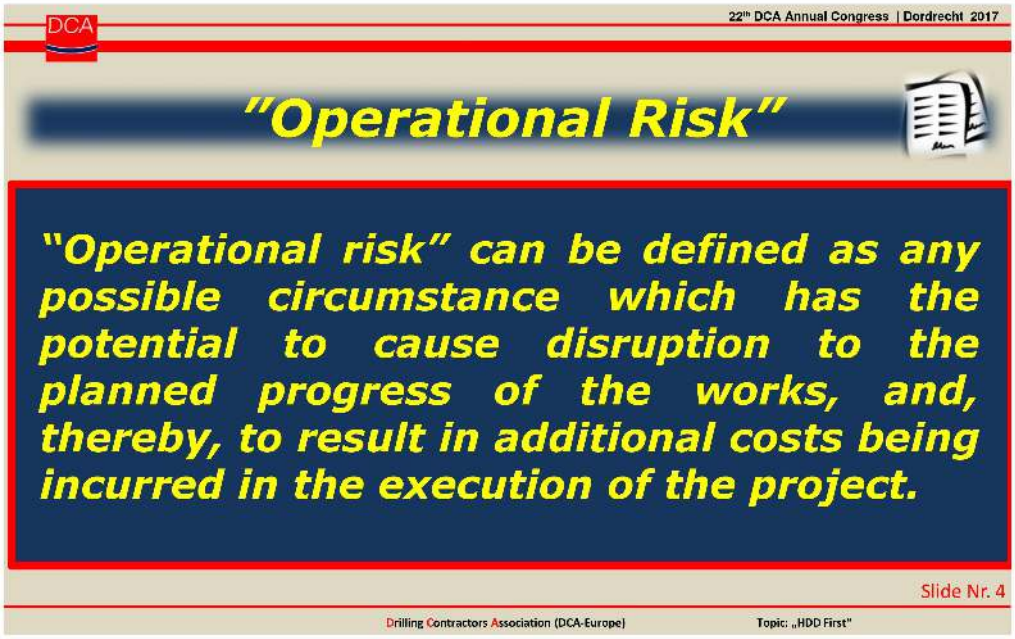
RISK
"Risk" is defined as a circumstance or eventuality involving exposure to danger or to loss.
Concise Oxford English Dictionary
Slide Nr. 3
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"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"Operational Risk"
"Operational risk" can be defined as any possible circumstance which has the potential to cause disruption to the planned progress of the works, and, thereby, to result in additional costs being incurred in the execution of the project.
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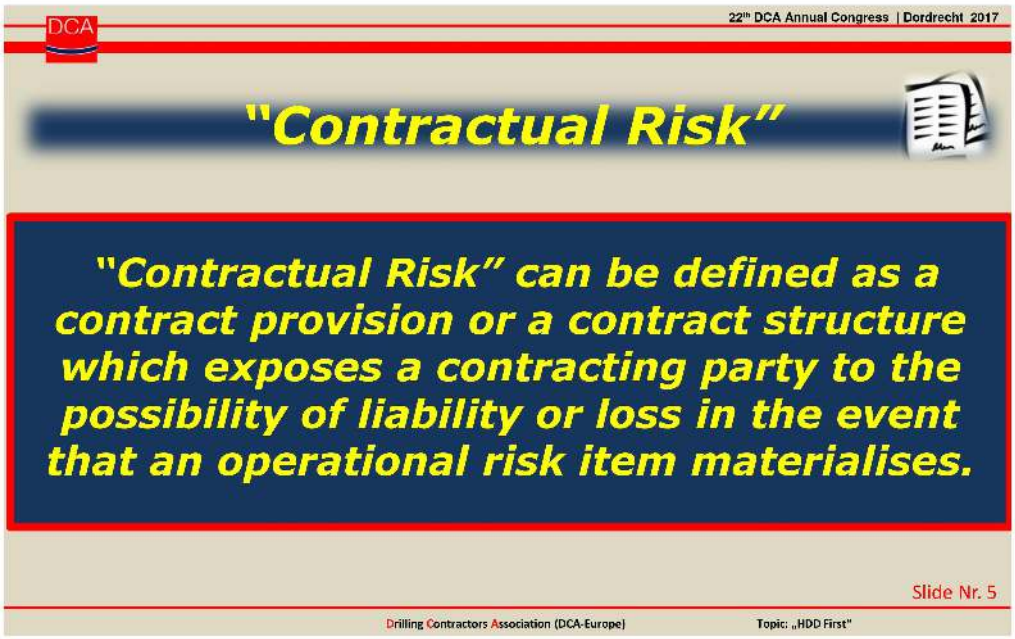
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"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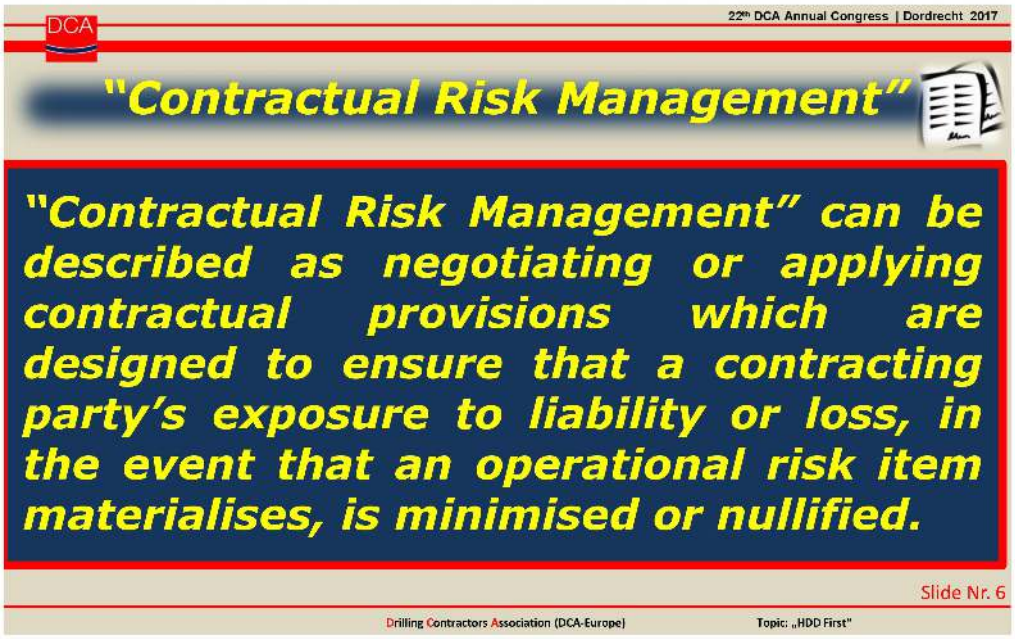
"Contractual Risk"
"Contractual Risk" can be defined as a contract provision or a contract structure which exposes a contracting party to the possibility of liability or loss in the event that an operational risk item materialises.
Slide Nr. 5
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"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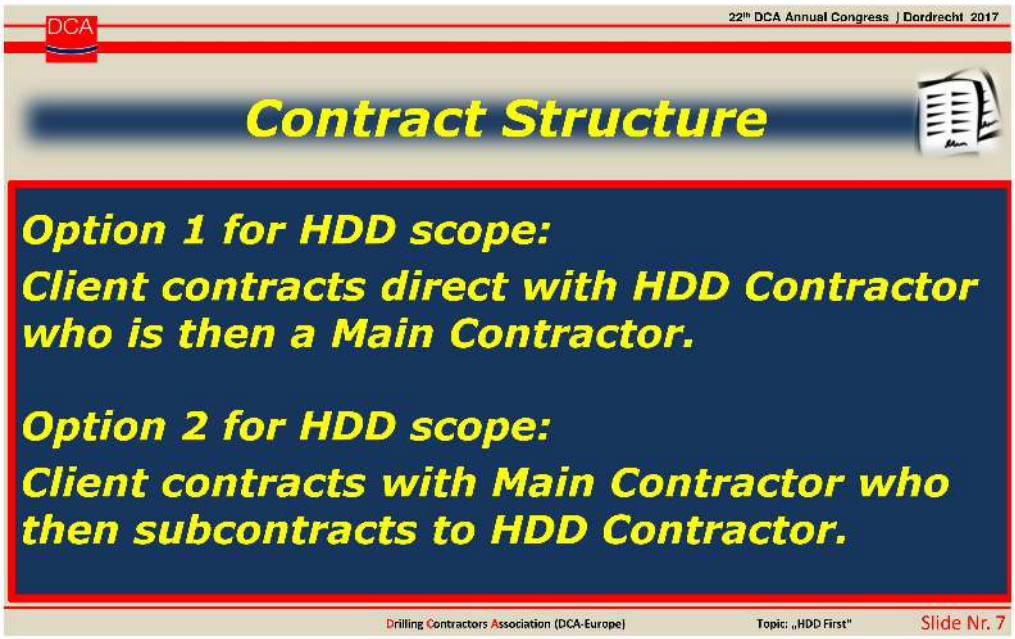
"Contractual Risk Management"
"Contractual Risk Management" can be described as negotiating or applying contractual provisions which are designed to ensure that a contracting party's exposure to liability or loss, in the event that an operational risk item materialises, is minimised or nullified.
Slide Nr. 6
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"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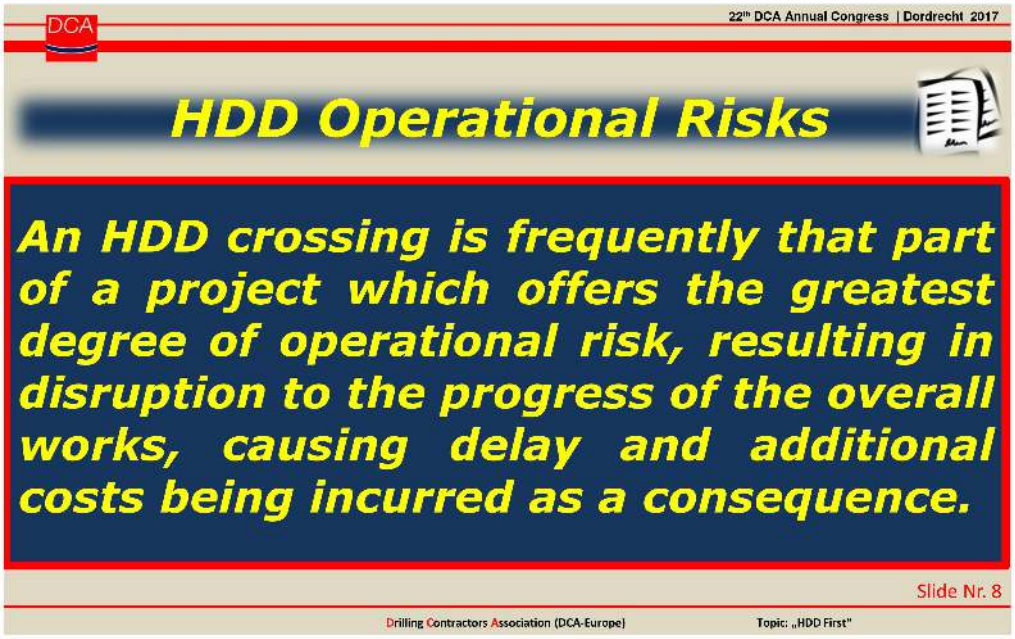
Contract Structure
Option 1 for HDD scope:
Client contracts direct with HDD Contractor who is then a Main Contractor.
Option 2 for HDD scope:
Client contracts with Main Contractor who then subcontracts to HDD Contractor.
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"
Slide Nr. 7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HDD Operational Risks
An HDD crossing is frequently that part of a project which offers the greatest degree of operational risk, resulting in disruption to the progress of the overall works, causing delay and additional costs being incurred as a consequence.
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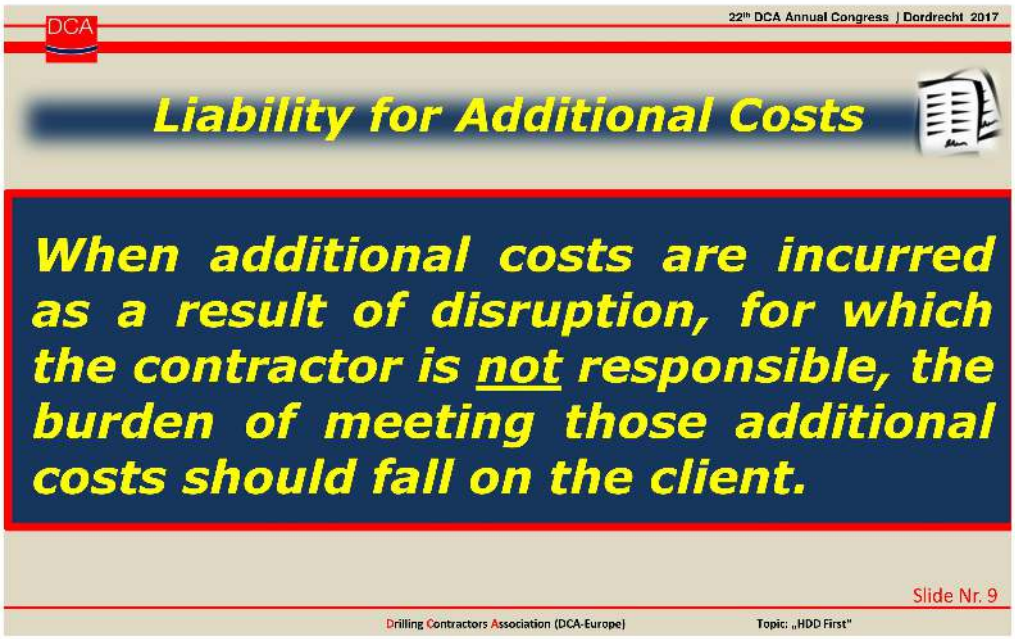
Topic: „HDD First"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Liability for Additional Costs
When additional costs are incurred as a result of disruption, for which the contractor is not responsible, the burden of meeting those additional costs should fall on the client.
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Topic: „HDD First"


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HDD Globally Utilised
HDD has become a globally utilised and highly regarded trenchless technology for the installation of buried infrastructure.
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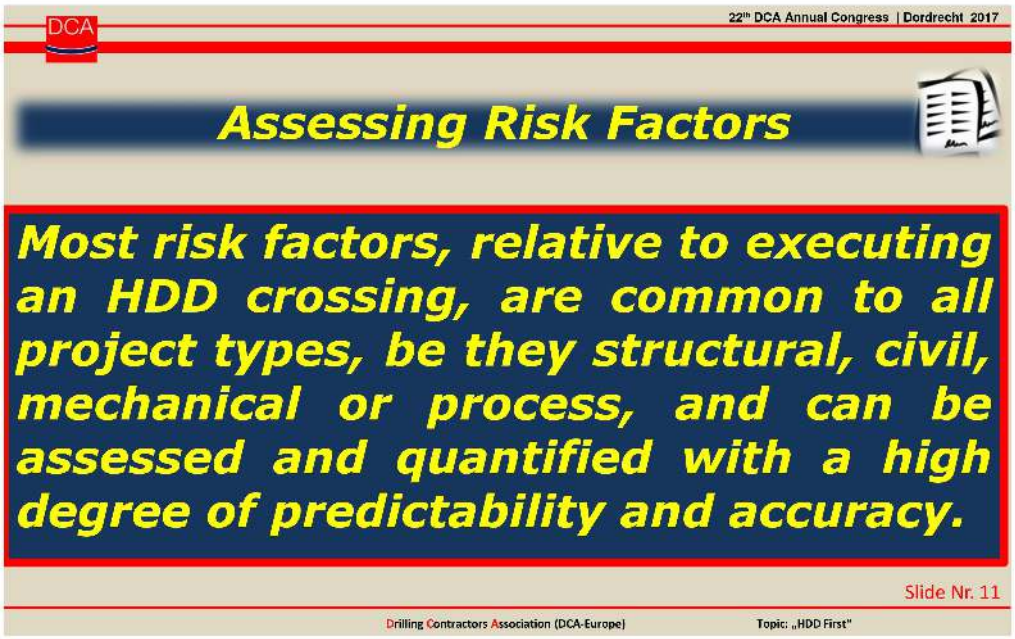
Topic: „HDD First"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Assessing Risk Factors
Most risk factors, relative to executing an HDD crossing, are common to all project types, be they structural, civil, mechanical or process, and can be assessed and quantified with a high degree of predictability and accuracy.
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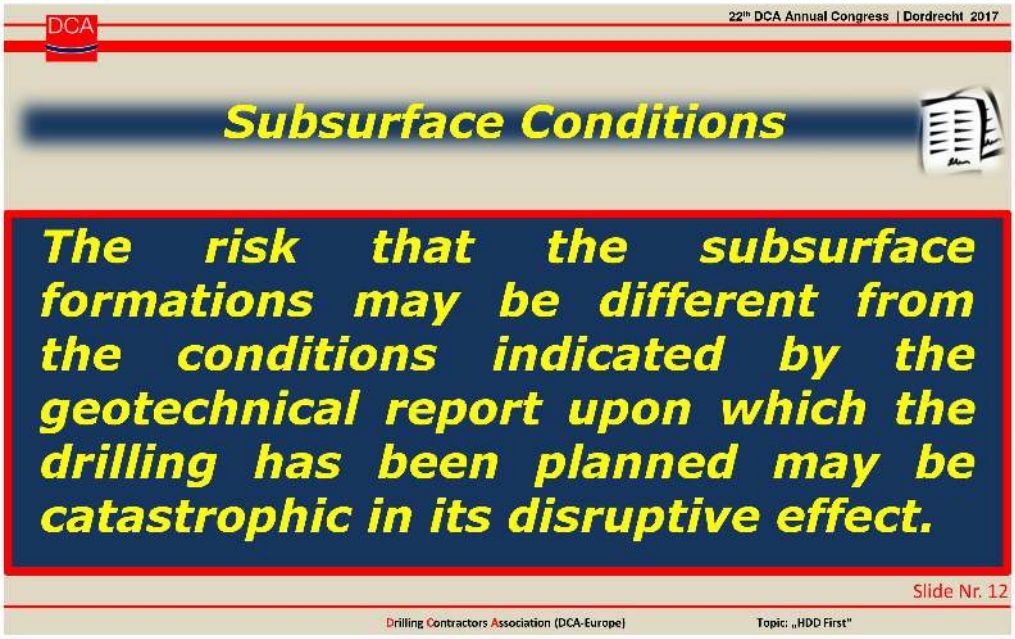
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Subsurface Conditions
The risk that the subsurface formations may be different from the conditions indicated by the geotechnical report upon which the drilling has been planned may be catastrophic in its disruptive effect.
Slide Nr. 12
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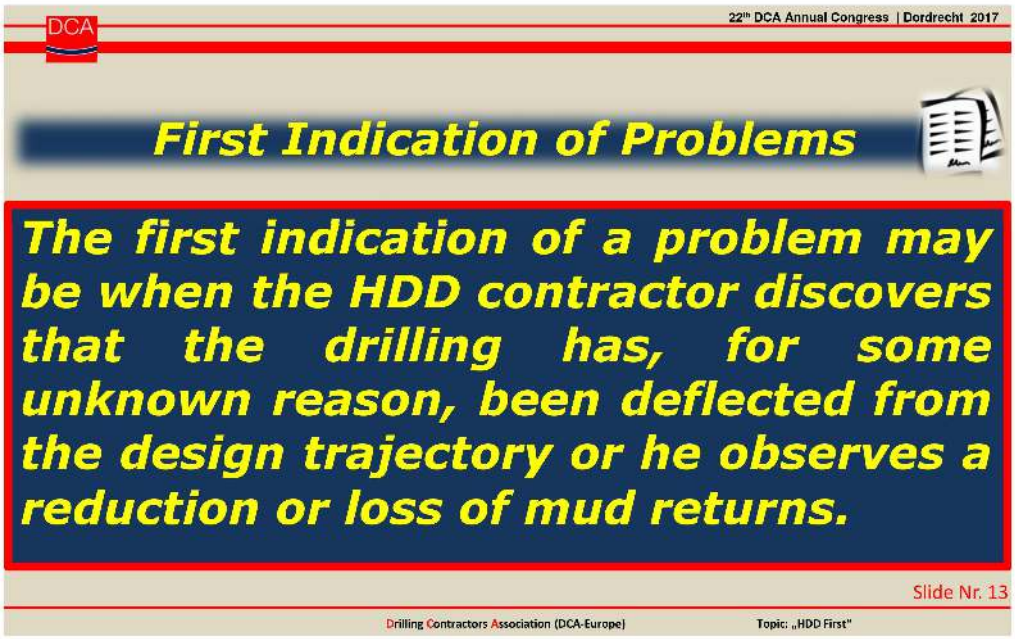
Topic: „HDD First"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First Indication of Problems
The first indication of a problem may be when the HDD contractor discovers that the drilling has, for some unknown reason, been deflected from the design trajectory or he observes a reduction or loss of mud returns.
Slide Nr. 13
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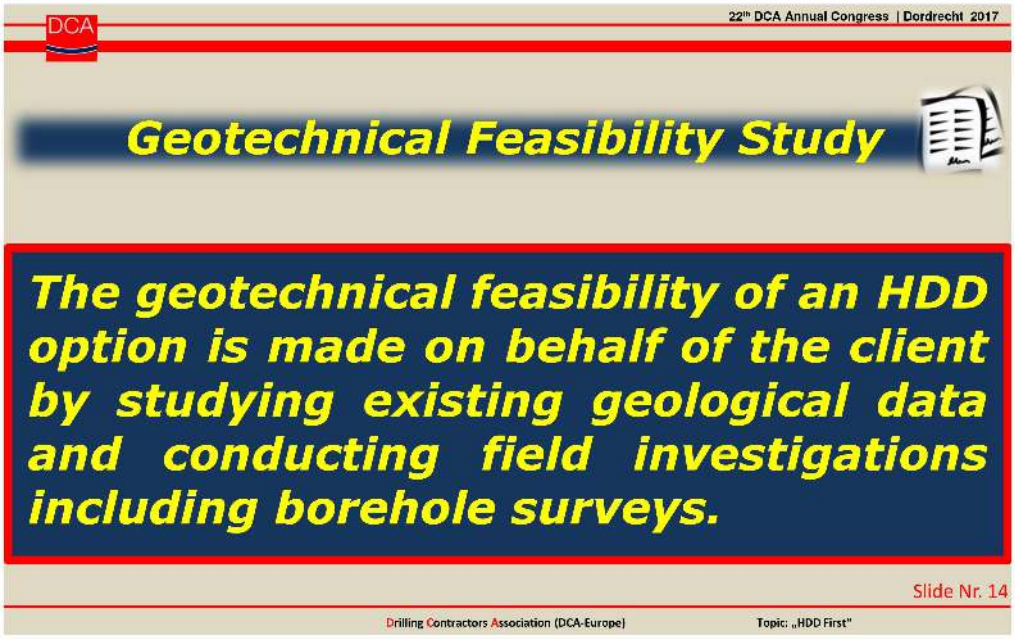
Topic: „HDD First"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Geotechnical Feasibility Study
The geotechnical feasibility of an HDD option is made on behalf of the client by studying existing geological data and conducting field investigations including borehole surveys.
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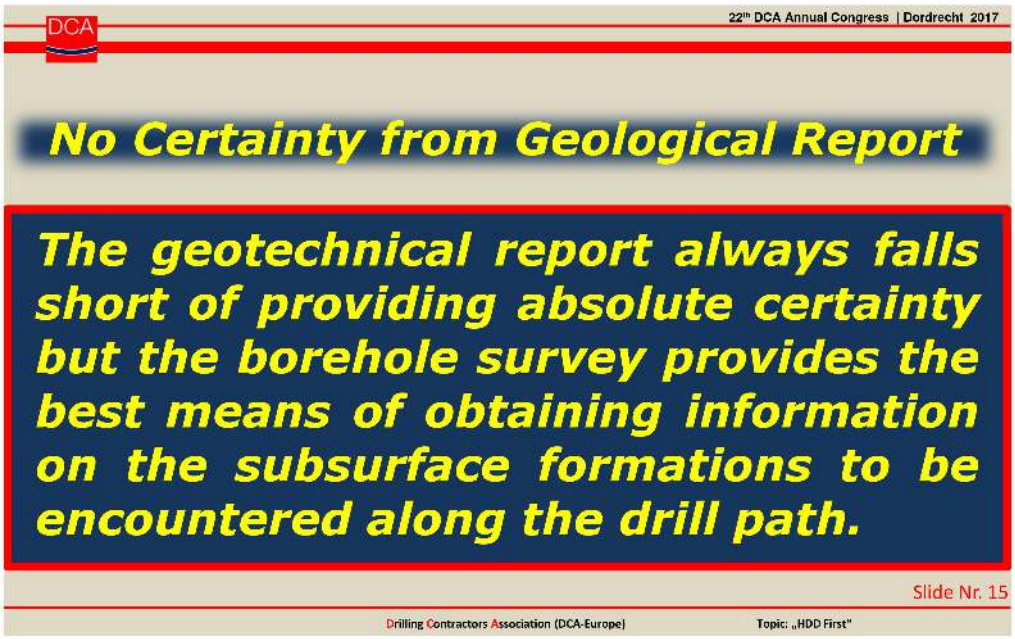
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No Certainty from Geological Report
The geotechnical report always falls short of providing absolute certainty but the borehole survey provides the best means of obtaining information on the subsurface formations to be encountered along the drill path.
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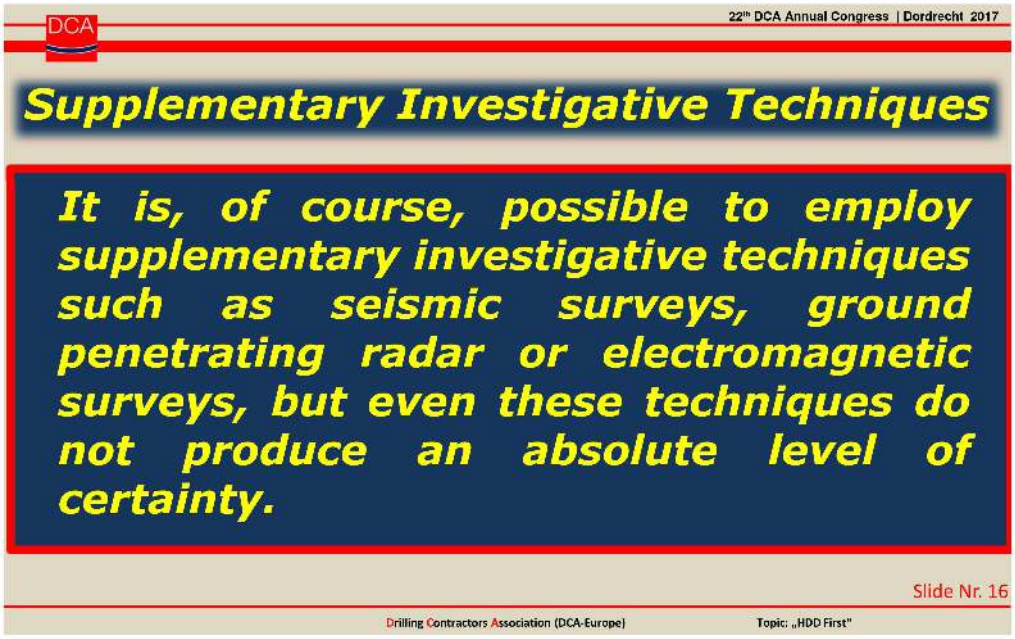
Topic: „HDD First"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Supplementary Investigative Techniques
It is, of course, possible to employ supplementary investigative techniques such as seismic surveys, ground penetrating radar or electromagnetic surveys, but even these techniques do not produce an absolute level of certainty.
Slide Nr. 16
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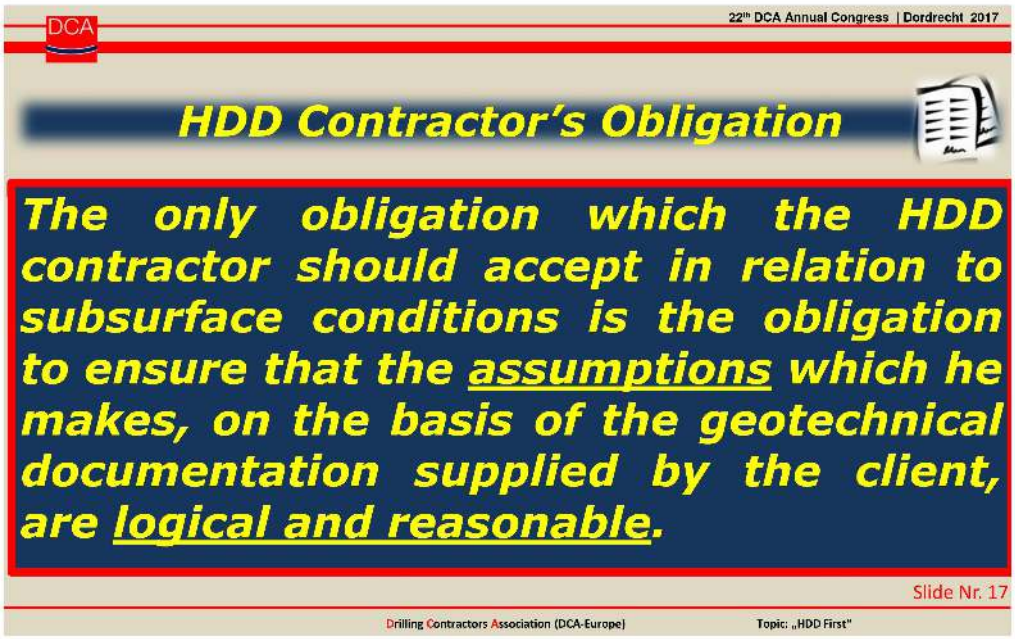
Topic: „HDD First"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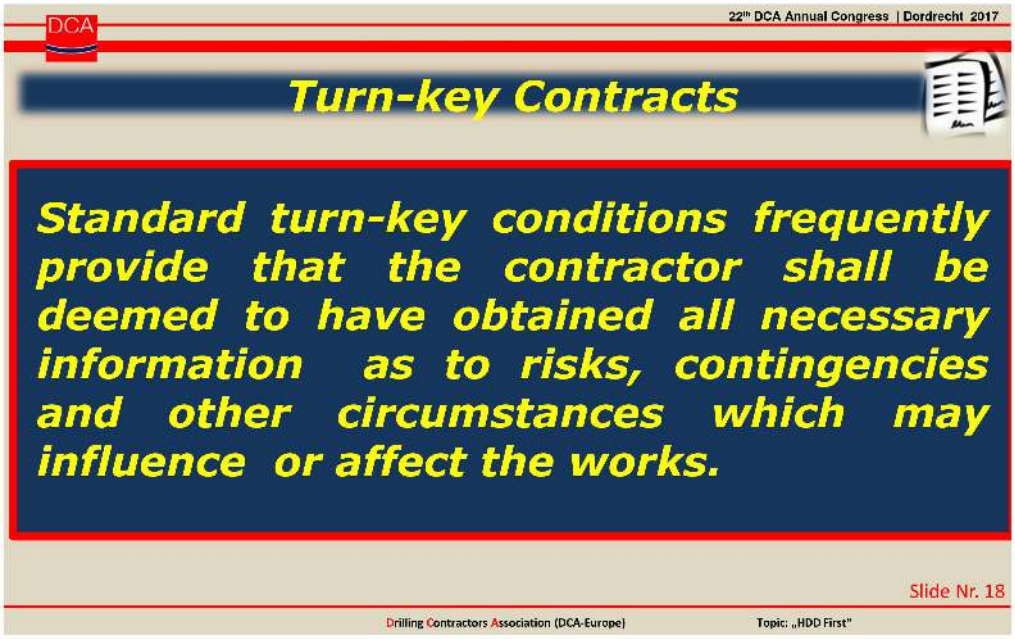
HDD Contractor's Obligation
The only obligation which the HDD contractor should accept in relation to subsurface conditions is the obligation to ensure that the assumptions which he makes, on the basis of the geotechnical documentation supplied by the client, are logical and reasonable.
Slide Nr. 17
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"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Turn-key Contracts
Standard turn-key conditions frequently provide that the contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the works.
Slide Nr. 18
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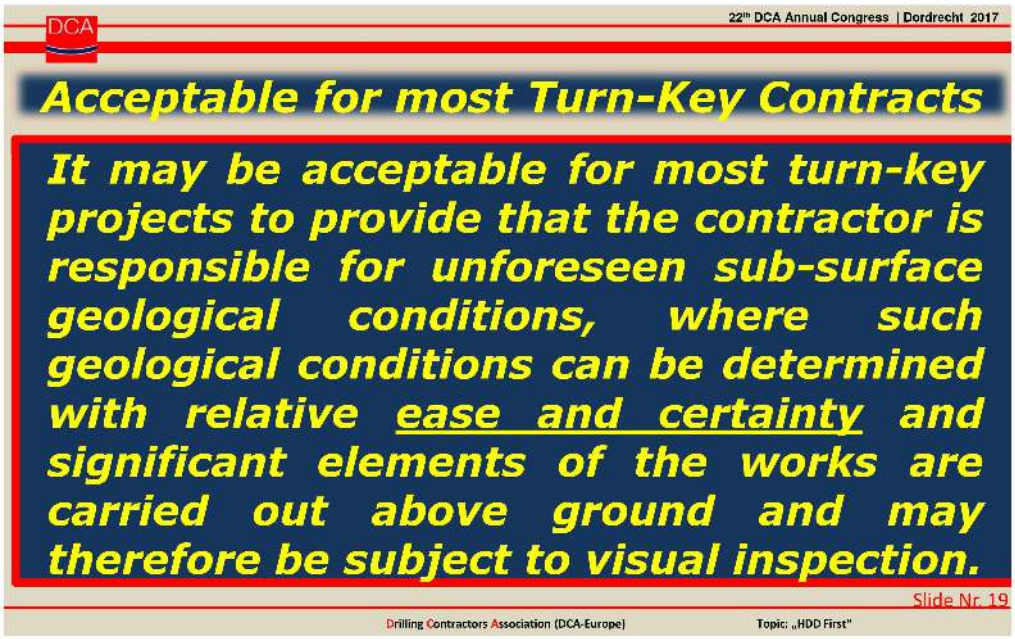
Topic: „HDD First"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Acceptable for most Turn-Key Contracts
It may be acceptable for most turn-key projects to provide that the contractor is responsible for unforeseen sub-surface geological conditions, where such geological conditions can be determined with relative ease and certainty and significant elements of the works are carried out above ground and may therefore be subject to visual inspection.
Slide Nr. 19
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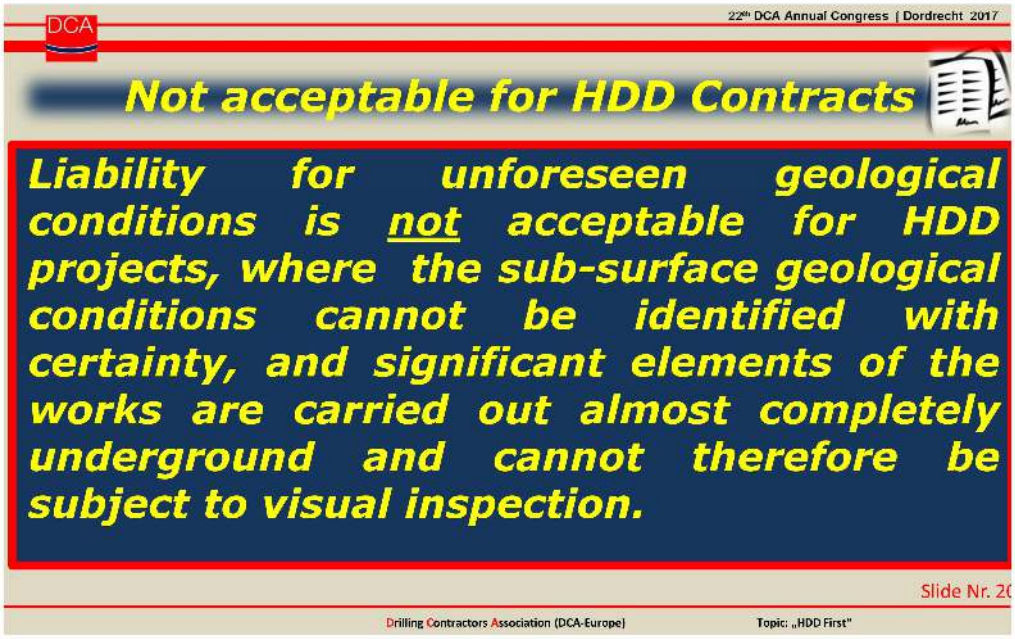
Topic: „HDD First"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Not acceptable for HDD Contracts
Liability for unforeseen geological conditions is not acceptable for HDD projects, where the sub-surface geological conditions cannot be identified with certainty, and significant elements of the works are carried out almost completely underground and cannot therefore be subject to visual inspection.
Slide Nr. 20
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Topic: „HDD First"


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HDD First Principle
The HDD contractor accepts no liability for subsurface conditions beyond a liability for ensuring that conclusions which he forms, from a study of the geotechnical report, are logical and reasonable.
Slide Nr. 21
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Topic: „HDD First"


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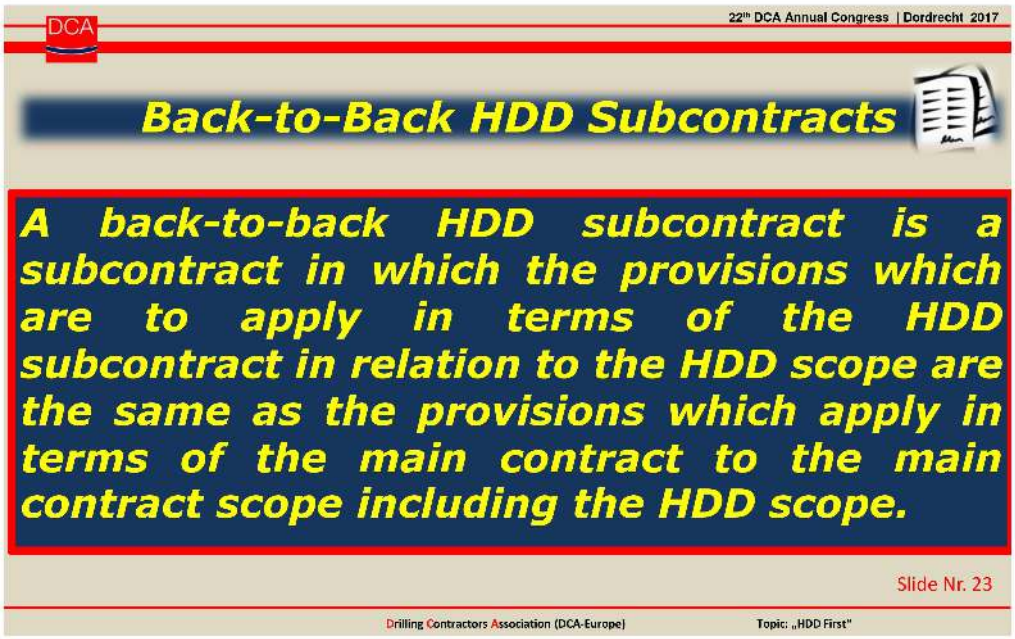
Types of Contract
Generally speaking, the types of contract available are unit price contracts, daily rate contracts, cost plus contracts, target price contracts, and lump sum contracts, with lump sum contracts being by far the most common.
Slide Nr. 22
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"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Back-to-Back HDD Subcontracts
A back-to-back HDD subcontract is a subcontract in which the provisions which are to apply in terms of the HDD subcontract in relation to the HDD scope are the same as the provisions which apply in terms of the main contract to the main contract scope including the HDD scope.
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Back-to-Back Subcontracts Qualifications
(1) Liability for Subsurface Conditions
(2) Main Contractor's Claim Liability
(3) General Caps on Liability
(4) Payment Terms
Slide Nr. 24
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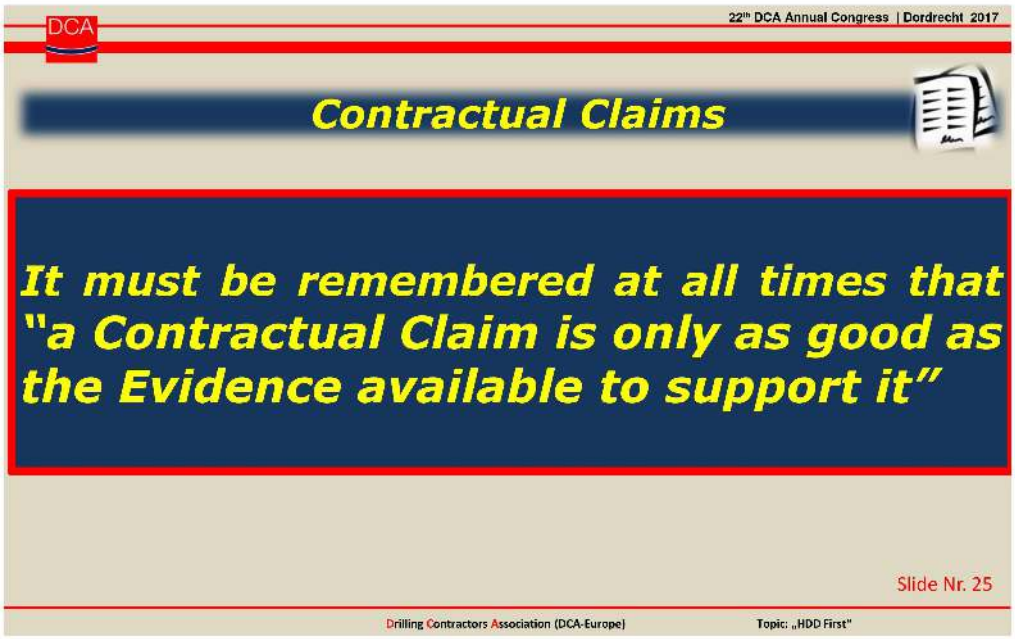
Topic: „HDD First"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Contractual Claims
It must be remembered at all times that "a Contractual Claim is only as good as the Evidence available to support it"
Slide Nr. 25
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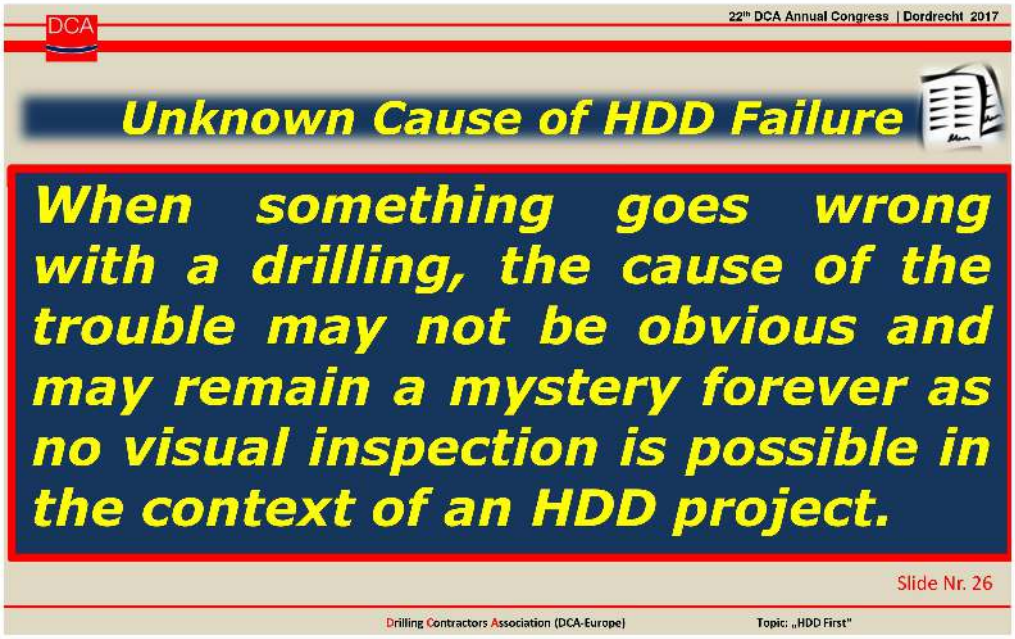
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Unknown Cause of HDD Failure
When something goes wrong with a drilling, the cause of the trouble may not be obvious and may remain a mystery forever as no visual inspection is possible in the context of an HDD project.
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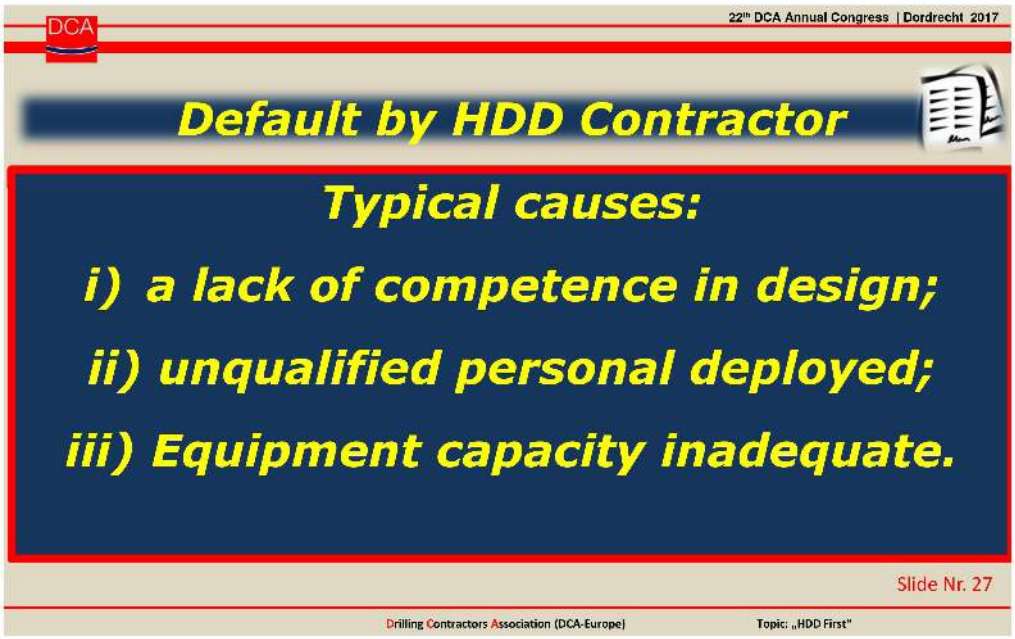
Topic: „HDD First"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Default by HDD Contractor
Typical causes:
i) a lack of competence in design;
ii) unqualified personal deployed;
iii) Equipment capacity inadequate.
Slide Nr. 27
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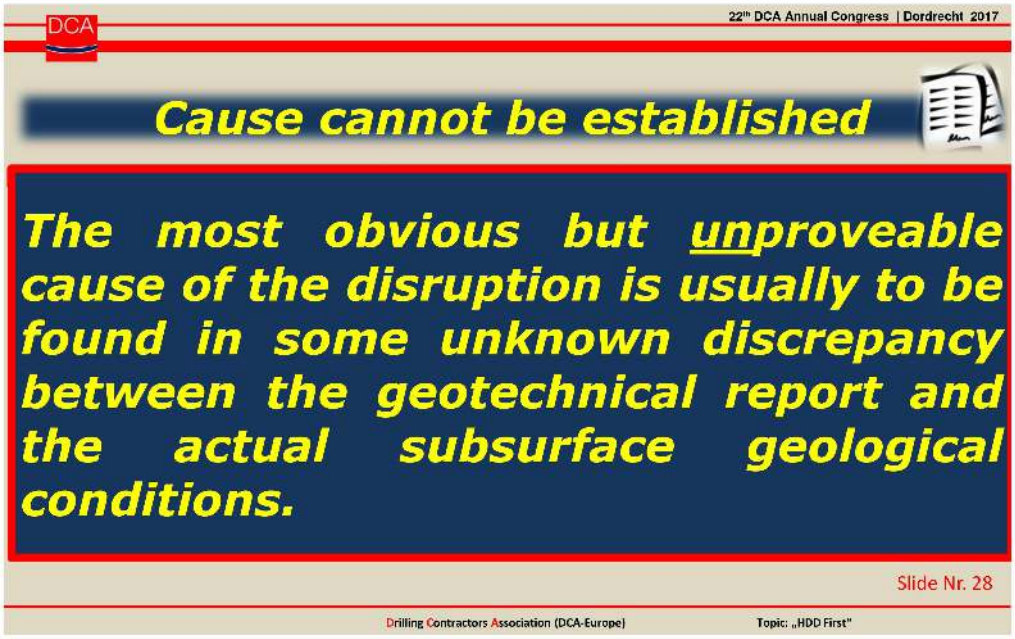
Topic: „HDD First"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Cause cannot be established
The most obvious but unproveable cause of the disruption is usually to be found in some unknown discrepancy between the geotechnical report and the actual subsurface geological conditions.
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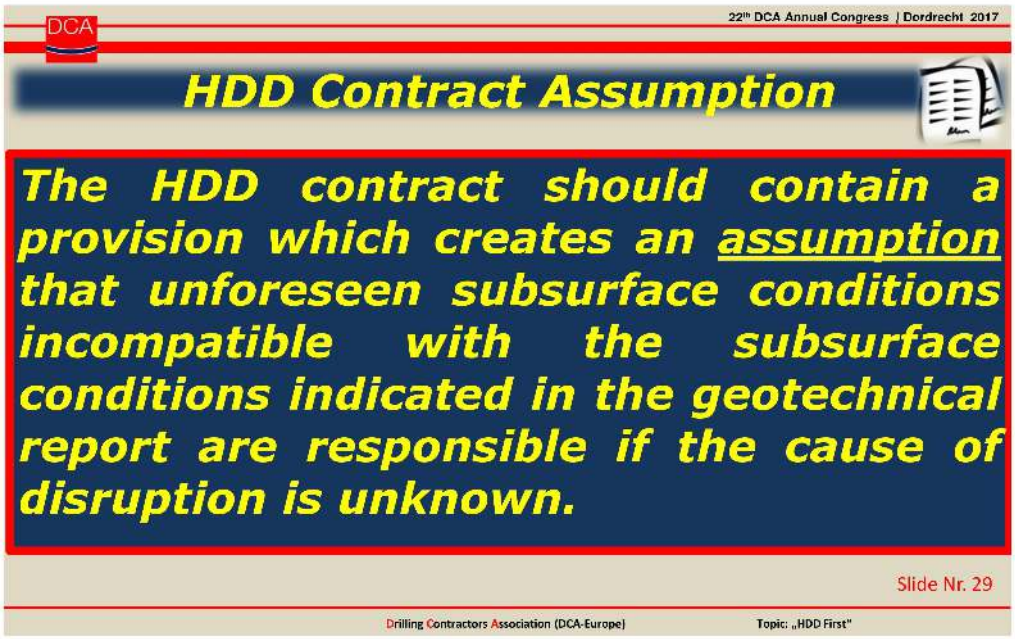
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HDD Contract Assumption
The HDD contract should contain a provision which creates an assumption that unforeseen subsurface conditions incompatible with the subsurface conditions indicated in the geotechnical report are responsible if the cause of disruption is unknown.
Slide Nr. 29
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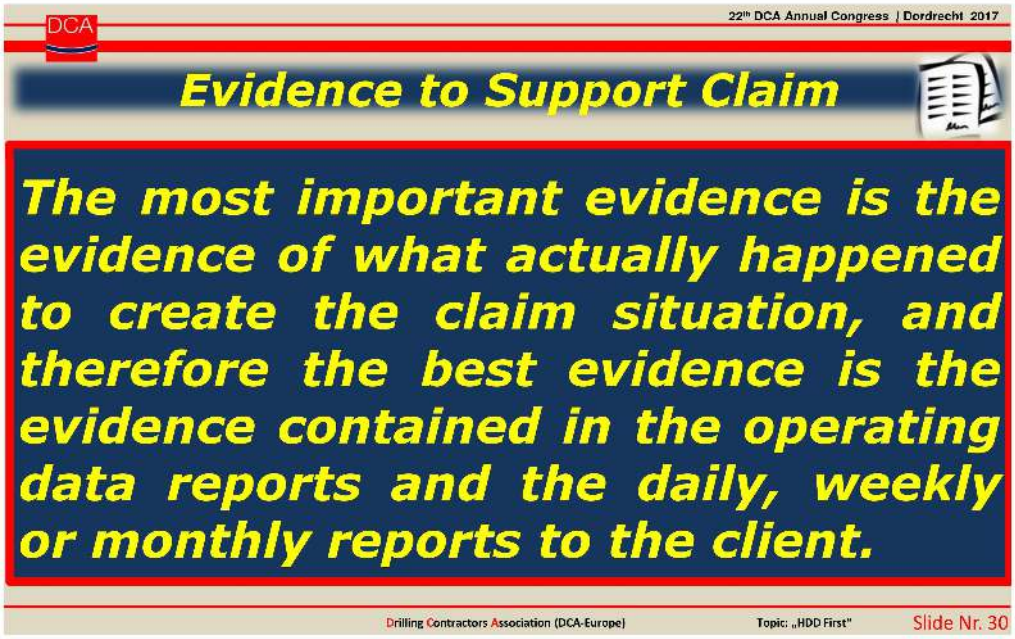
Topic: „HDD First"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Evidence to Support Claim
The most important evidence is the evidence of what actually happened to create the claim situation, and therefore the best evidence is the evidence contained in the operating data reports and the daily, weekly or monthly reports to the client.
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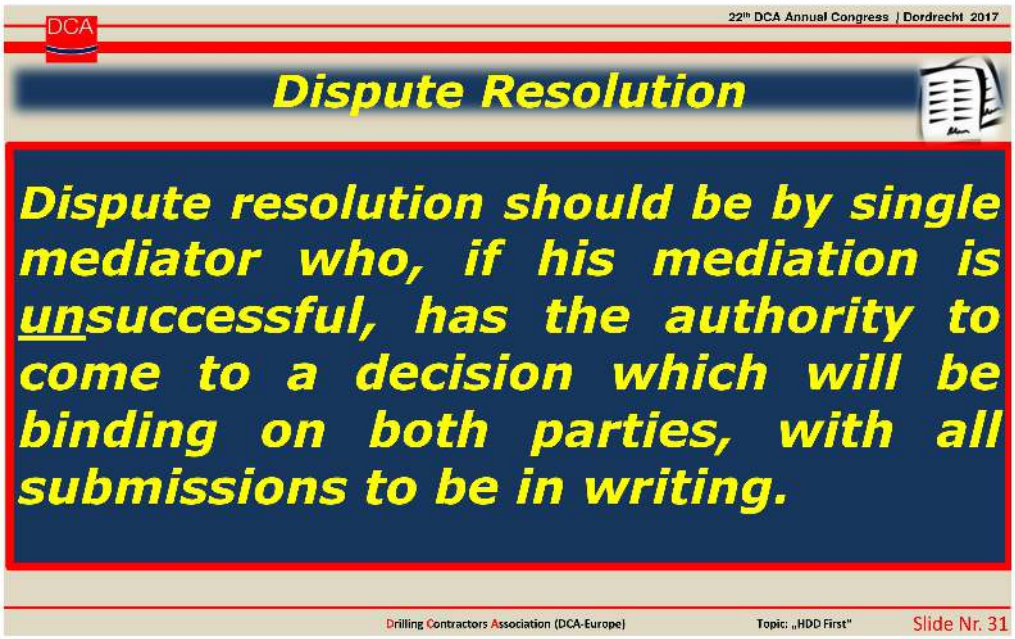
Slide Nr. 30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Dispute Resolution
Dispute resolution should be by single mediator who, if his mediation is unsuccessful, has the authority to come to a decision which will be binding on both parties, with all submissions to be in writing.
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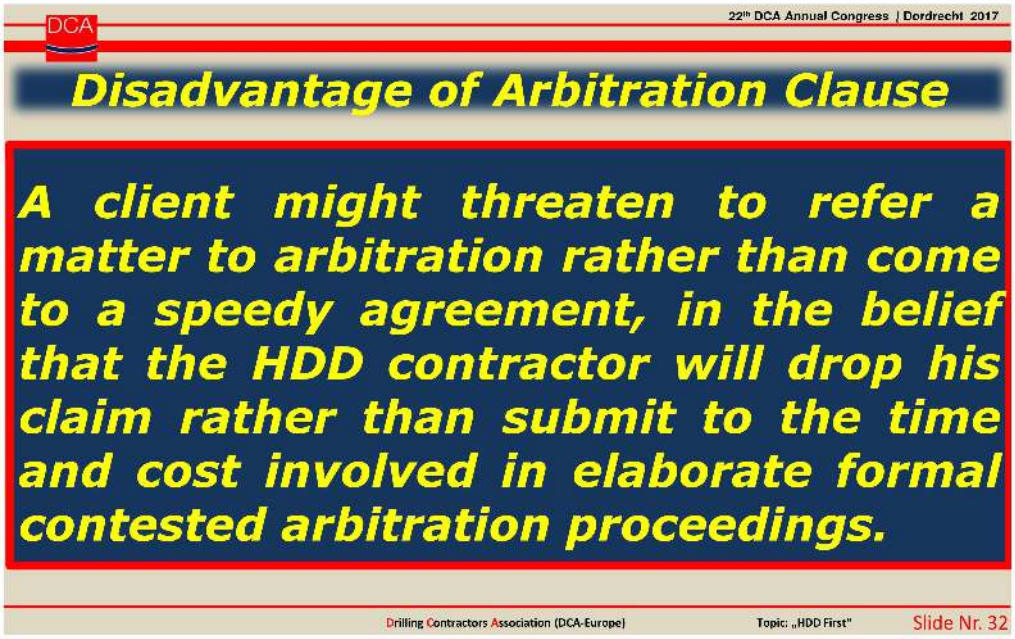
Slide Nr. 31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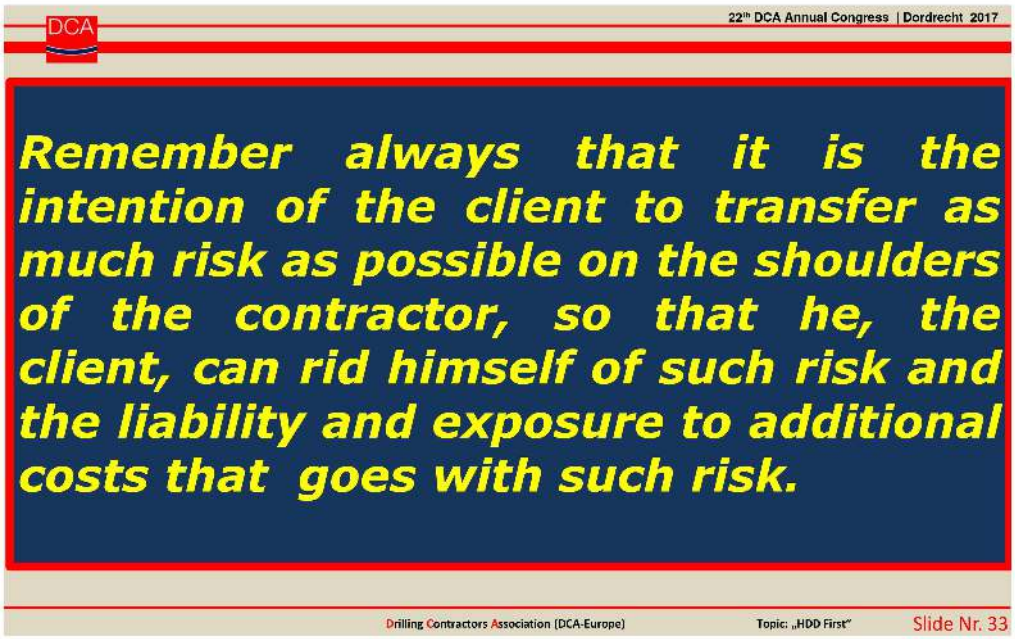
Disadvantage of Arbitration Clause
A client might threaten to refer a matter to arbitration rather than come to a speedy agreement, in the belief that the HDD contractor will drop his claim rather than submit to the time and cost involved in elaborate formal contested arbitration proceedings.
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"
Slide Nr. 32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Remember always that it is the intention of the client to transfer as much risk as possible on the shoulders of the contractor, so that he, the client, can rid himself of such risk and the liability and exposure to additional costs that goes with such risk.
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"
Slide Nr. 33


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Successful Project Requirements:
Acceptable Terms and Conditions;
Excellent Engineering Design;
Satisfactory Contract Price;
Experienced Project Manager;
Highest Technical Standards;
Reliable Contract Manager.
Drilling Contractors Association (DCA-Europe)
Topic: „HDD First"
Slide Nr. 34


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Topic: „HDD First"

Interconnector Bulgaria-Romania / Danube Crossing Marten-Comasca

Some years ago, the Bulgarian and Romanian governments applied with the EU for co-financing to upgrade the existing cross-border gas supply network, resulting from that an invitation to tender was issued in 2011. That tender focused on the installation of three pipelines below the River Danube between Comasca in Giurgiu County (Romania) and Marten in Ruse County (Bulgaria). These works were aimed at replacing the existing culverts, which were installed by means of open cut method more than 60 years ago, which could only be operated with the low pressure due to their present poor condition.

An EPC contract was set-up to cover the requirement for three horizontal drillings each 2100 m in length, whereby one DN 150 = 6" cable protection pipe and two DN 500 = 20" gas pipes had to be installed, including all secondary work.

The contract for the execution of this work was won in 2012 by a Romanian horizontal drilling company. The 6” line was successfully built. Later, in the first half of 2014 that company had to abandon their efforts as the lack of success on the execution of the drilling work for the first 20“ line had led to them filing for bankruptcy.

Several attempts were then made to find an alternative contractor until the bidding consortium HABAU PPS Romania and INSPET won the contract for the execution and completion of those work. It needs to be noted that the project had to be completed by Christmas 2016, as otherwise EU co-financing would no longer be available.

During the new round of tendering in 2014-2015 LMR had submitted subcontract offers to various companies and were close to being awarded the HDD works but were ultimately not successful. Later, in the spring of 2016, HABAU PPS also requested an offer from LMR and, contrary to expectations, LMR’s offer was accepted and HABAU PPS awarded LMR a subcontract for the execution of HDD drilling work for the two 20" gas pipelines.

One unusual characteristic of this work was that the ground conditions had been inadequately investigated at the time of award. Furthermore, there were rumours that adverse ground conditions had a significant part to play in the failure of the drilling works of the former Romanian drilling contractor. With that in mind, LMR prepared an offer with a drilling concept that covered various foreseeable scenarios and risks. The main assumptions were that the soil was heavily disturbed on the first 120 m along the drilling alignment and that mud losses could be expected on the remaining drilling section. Accordingly, it was proposed to install casing pipes along the first 120 m of the drill alignment and to have a concept for the rest of the drilling, which took into account significant or even total mud losses. The drilling concept also provided just one drill rig for the execution of drilling operations from the Bulgarian side.

After an intensive phase of engineering and planning development for the drilling operations and several coordination meetings with the Main Contractor, the pre-drilling works began in June. This included the installation of 120 m long casings for the start section of both bore holes which was carried out with the support of a specialized sub-contractor. With the drill entry points some 15 m above the river level and the ground level dropping relatively quickly, these casing pipes had the added benefit of providing a safeguard against mud breakouts to surface.

Picture 01: Pipe Trace

At the same time, a soil investigation campaign took place, covering the entire drill line for both river crossings. This provided 10 core drillings to depths of up to 100 m which became the basis for the development of a comprehensive ground model defining the distribution and juxtaposition of the varying soil types along the route. The results were far from ideal with the river crossings being located at a point where geological conditions were highly unfavourable. Nonetheless, with the connector stations on the Bulgarian and Romanian sides of the Danube already built there was no option to change the crossing point.

The ground on the Bulgarian side was interspersed with localised zones of heavy tectonic disturbance. The rest of the drill line did not prove to be much better, except that the frequency of the disturbed zones reduced from five disturbed zones in the first 200 m to ten further disturbed zones over the remaining 1,900 m. Otherwise, it was clear that more or less fractured limestone with uniaxial compressive strengths of between 30 and 160 MPa (the strength of porcelain) had to be passed through. With these prerequisites, LMR entered the race.

As expected, the casing pipe installation worked well and both casing pipes were completed within five weeks and was followed by the mobilisation of the HDD equipment.

Picture 02: Jobsite HDD1 View from East to West

On 2nd July 2016, drilling operations began. Soon, the first disturbed zone was encountered and it came as no surprise when total mud losses occurred immediately. What was a surprise, even to the geotechnical consultants on site, was the speed with which the drilling fluid ran away. This left the drill crew with the impression of having encountered a 'black hole' that had swallowed more than 60 m³ of drilling fluid within a few seconds!

The next month was characterized by cementations, which filled and sealed these disturbed loss zones. Cementing equipment and technology originating from the oil field was used on site. In addition, new cement slurry mixes were developed on the construction site, which allowed an even more efficient process for sealing each of these loss zones. In parallel, pilot drilling operations continued. The frequency of the cementations confirmed the aforementioned, generally negative, findings of the soil investigation campaign. Despite the fact that large volumes of sealing and filling material were pumped downhole, the extremely high frequency of fractures in conjunction with high groundwater flow rates probably explains the rapid removal of the sealing and filling material and the frequency of stops for cementation which came as a surprise to all the involved parties. This led to an undesirable delay in the construction period.

As a result, discussions soon started to consider how to minimise the delays and what could potentially be done to finish the project before the winter break. At the end of July, 40% of the first pilot drill was complete but had already taken 115% of the allotted construction time for that operation. These discussions continued with inputs from all parties. The Client and construction companies stood with their backs to the wall as a construction time analysis made clear that, if everything went well, only the first crossing would just be completed by Christmas 2016. This would have put the EU co-financing at risk.

Picture 03: Jobsite HDD1 View from West to East

Eventually, the Main Contractor and Client decided that drilling works were to continue and with full mud losses where necessary. With this being the case, some additional specialist equipment, partially owned by LMR, was mobilised. It was also decided that so as to ensure that the end date could be kept drilling was to continue on a multi shift basis (24 hours, 7 day week). Consequently, the first pilot drilling was completed on 27th August at 23:28 hrs. This was a great relief for all parties with extremely high forces: torque > 80 KNm and push forces > 900 KN required to finish the pilot borehole. This was only feasible using LMR's world-leading drill pipe specification.

Subsequently, the enlargement of the borehole began. However, this had to stop quickly as torque forces acting on the drill string were permanently in the overload range > 90 kNm on the first 10 drill rods (from 215). That created a defect at one of the rotary motors on the drill rig, which was repaired and modified by the drill crew on site. In addition, the borehole was checked with a specially designed drilling tool, developed by LMR. That tool aimed to reduce the forces on the drill string. After the successful check trip with that tool the borehole could be enlarged.

The reaming of a long borehole through rock is a stern challenge as the drill string is a 2100 m long drive shaft for the hole-opener. The handling of the drill tool by the operators was a difficult task as the drill string, over such lengths, tends to twist several times before the drilling tool, a hole-opener, begins to work on the bottom of the borehole. At the same time, in the case of rock drilling, an added risk is that such tools occasionally jam temporarily (for some seconds, before the rock breaks away) – which leads to an even more uneven performance. Risks relating to this include the breaking of drill pipes or the loosening of threaded connections, which then leads to time-consuming rescue or recovery works.

While the drill string was undamaged a situation arose whereby the drill string in the borehole unscrewed due to the aforementioned "slip-stick effect". Fortunately, it proved possible to immediately re-

connect the drill string due to the prudent and far-sighted action of the driller. Following this incident, the drill string was again torqued up and then the reaming operations could be successfully completed.

Picture 04: Hope Opener after reaming HDD1

The reaming was followed by a check-trip and another run through the bore hole with a dummy. The dummy-run was to prove that the anti-corrosion coating system could resist the forces which would act on that product during pullback. This was necessary as the GRP coated product pipe for the first crossing had already been laying on site in a prefabricated and unprotected condition for 3 years and tests in the summer of 2016 resulted in at least parts of this coating having to be repaired. The dummy-run showed significant damages to the coating. Despite these negative warning signs, the first product pipe was successfully pulled in consultation and upon request of the beneficiary. A subsequent intensive measurement showed no damage to the insulation system, which was met with great relief.

Picture 05: Exit point pull back HDD1

With the background of winter working conditions which may have stopped the HDD works, the Main Contractor and Client together with LMR had been discussing the planning of the second crossing throughout the reaming operations on the first drill. The key question was what could be done to accelerate the second river crossing in a quick and reliable manner. These conversations led to an adapted new drilling concept, whereby major parameters are shown hereafter:

1. The use of a new, modified drilling assembly and drilling programme.
2. Reduction of the length of sections of the bore hole where cementation operations shall take place in case of mud losses.
3. Performing a meeting in the middle and to accept the unavoidability of mud losses should they materialise.
4. Starting drilling operations as soon as possible on a multiple 24/7 shift basis.

The first pullback was followed by an exhilarating pipe fest and the moving of the drill rig and the preparation, in parallel, of the additional drilling rig on the Romanian construction site near Comasca. Then the pilot drilling on the second crossing could begin. This was to a great extent free of problems on the Romanian side, until at approx. 1400 m drilling distance the pilot drilling operations were stopped, in order to wait for the "pilot" coming from Bulgaria. Pilot drilling operations, starting in Bulgaria progressed also better than anticipated. Just one cementation (compared to > 8 on HDD1) was required.

One unexpected challenge was encountered when the drill string was strongly deflected at approximately 400 m distance. The formations encountered at that position were unfavourably aligned with respect to the drill alignment, were locally very karstic and showed frequent changes in hardness (soft rock – hard rock = rock lasagne). This required a time-consuming correction of the drill line but after several days the procedure was complete and the meeting (= intersect) could proceed.

To effect the intersect, the Bulgarian pilot passed the Romanian pilot and with the support of specialised borehole surveying tools, the distance between the two steering probes inside the pilot drill assemblies could be determined. Based on this, bore path correction parameters were evaluated and calculated and the pilot drilling could be continued. This process was repeated several times until finally the Bulgarian pilot entered the borehole of the Romanian pilot. This was carried out within the limits of the pre-determined elastic bending radii of the product pipe for the load case “test- pressure”. Afterwards, the Romanian pilot was quickly tripped out and the Bulgarian pilot was pushed forwards. This worked very well although 80 m before the exit point the Bulgarian pilot drill assembly drifted out of the bore hole in locally occurring soft soils. However, this happened in jettable, soft soils and the rock drilling assembly on the end of the Bulgarian pilot string was used with success in drilling to the Romanian exit point. That "Plan B operation" was not planned but helped in achieving and accessing the target exit-point in Romania.

After the successful completion of the pilot drilling, the bore hole was enlarged. With the experience gained on the first drill, the objective was to avoid the occurrence of high torques on the drill string. To achieve this goal, the drilling rig on the Romanian site was modified by LMR. This resulted in both drill rigs being able to rotate and pull the drill string in the borehole simultaneously. In this manner, the torque on the drill string was reduced from 90 - 100 kNm (HDD 1) to 10 - 65 kNm (HDD 2).

This enabled progress during the reaming of the borehole at a much improved rate with these works taking 10 days to complete, much closer to the original programme. Despite the loss zones encountered during pilot drilling, a special drilling fluid configuration and conditioning enabled mud return flow to be maintained for almost 1,800 m of the hole. In this respect, a great deal of praise to the mud engineers and the team on the mixing tanks that handled those works very well.
After the borehole was reamed, a check-trip was carried out. This was done to ensure that the bore hole was free from obstacles. The check-trip was also used to confirm the forces acting on the drill string during pilot drilling and reaming. These forces were compared with the values of the first crossing, too. The good quality of the bore hole could be confirmed with the check-trip and the pullback could then be carried out with great success with completion within 18½ hours with this final drilling operation complete on 4th November at 17:38 hrs local time, well before the beginning of the winter and to the great pleasure of the Client, the Main Contractor - and to be honest - also to the great relief of LMR.

Result

For LMR, this project was the first big HDD job site in the Balkans. It is not surprising that in Bulgaria and Romania some situations and challenges are assessed differently to Western Europe. The high levels of self-motivation and initiative shown by local partner companies and, in particular, the support from the Local Authorities were a positive surprise. Never giving up hope and constantly asking ourselves the question ‘What can be improved?’ was very important for LMR as was the open exchange of these thoughts with the Client and the Main Contractor. In this context, all changes to the drilling procedures and drilling equipment were proven to be of great benefit.

Picture 06: Pull Back

HDD-First

Project: Danube Crossing – Interconnector
Planning HDD: LMR Drilling GmbH
Client: Bulgartransgaz + Transgaz Romania
Main Contractor: HABAU PPS Romania (together with. INSPET)
Contractor (HDD): LMR Drilling GmbH
Subcontractors: Prime Horizontal for bore hole steering services, HEADS for drilling fluid engineering
Construction period: June 2016 – November 2016
Staff: the complete team of LMR
Equipment: Rig: 3500.180.1 und 2500.120.3 with complete additional equipment (double) and 3000 m drill pipes

Interconnector Bulgarien-Rumänien / Donaudüker Crossing Marten-Comasca

Die bulgarischen und rumänischen Regierungen haben sich vor einigen Jahren bei der EU um eine Kofinanzierung für die Instandsetzung des bestehenden grenzüberschreitenden Gasversorgungsnetzwerkes bemüht. Aus diesen Aktivitäten ist 2011 eine Ausschreibung hervorgegangen, die zum Inhalt hatte, dass unter der Donau zwischen Comasca, Rumänien und Marten, Bulgarien, drei Rohrleitungen verlegt werden sollten. Diese zielten darauf ab, vorhandene, in den 50er Jahren offen verlegte Düker zu ersetzen, die gegenwärtig, bedingt durch den maroden Zustand, nur noch im Niedrigdruckbereich betrieben werden können.

Diese Arbeiten sahen im Sinne eines EPC Vertrags vor, 3 Horizontalbohrungen von jeweils 2100 m Länge für 1 Kabelschutzrohr DN 150 = 6“ und 2 Gasleitungen DN 500 = 20“, einschließlich aller Nebenarbeiten, auszuführen.

Der Auftrag für die Ausführung dieser Arbeiten wurde in 2012 von einer rumänischen Horizontalbohrfirma gewonnen. Diese baute und bohrte mit Erfolg die 6“ Leitung, musste dann aber in der ersten Hälfte des Jahres 2014 aufgeben, da mangelnder Erfolg bei Ausführung der HDD Bohrarbeiten für die erste 20“ Leitung in die Insolvenz geführt hatte.

Daraufhin wurden die Arbeiten in mehreren Anläufen neu ausgeschrieben, bis im Frühjahr 2016 das Bieterkonsortium HABAU PPS Romania und INSPET den Zuschlag für die Ausführung und Beendigung der angefangenen Arbeiten bekam. Wichtig dabei war, dass die Maßnahmen bis Weihnachten 2016 abgeschlossen sein mussten, da sonst eine Kofinanzierung durch die EU entfallen wäre.

Als Subunternehmer hatte LMR an verschiedene Firmen Angebote abgegeben. Während der Neuausschreibungen in den Jahren 2014 – 2015 standen wir zwischenzeitlich dicht vor einer Auftragsvergabe, kamen dann aber letztendlich zu keinem Erfolg im Sinne einer Beauftragung der HDD Arbeiten. Später, im Frühjahr 2016 wurde auch an die Fa. HABAU PPS ein Angebot für die HDD Arbeiten abgegeben – und daraufhin gewann LMR wider Erwarten den Wettbewerb.

LMR wurde dann also von dem o. g. Konsortium mit der Ausführung der HDD Bohrarbeiten für die 2 20“ Gasleitungen beauftragt. Das Besondere an diesen Arbeiten war der Baugrund, dieser war zum Zeitpunkt der Beauftragung mangelhaft untersucht worden und es gab warnende Gerüchte bzgl. des Scheiterns der Bohrarbeiten der vorher tätigen rumänischen Bohrfirma. Mit diesem Hintergrund hatte LMR ein Bohrkonzept erstellt und angeboten, das verschiedene absehbare Szenarien und Risiken abdeckte. Die wesentlichen Annahmen waren, dass der Baugrund auf den ersten 120 m der Bohrlinie massiv gestört ist und dass auf der restlichen Bohrstrecke Spülungsverluste zu erwarten waren. Dementsprechend war vorgesehen, die ersten 120 m des Bohrloches zu verrohren und für den Rest der Bohrstrecke ein Konzept zu haben, mit dem schweren Spülungsverlusten begegnet werden konnte. Das Bohrkonzept sah außerdem vor, nur mit einem Bohrgerät, von der bulgarischen Seite aus, die Bohrarbeiten durchzuführen.

Nach einer intensiven Phase der Arbeitsvorbereitung für die Bohrarbeiten und mehreren Koordinationstreffen mit dem HU begannen dann die vorbereitenden Arbeiten im Juni. Dazu wurde mit Hilfe eines spezialisierten Subunternehmers die Verrohrung der beiden Bohrlöcher über jeweils 120 m Länge durchgeführt. Da die Eintrittspunkte der Bohrung dicht zu einem Geländeversatz lagen, bei dem die Geländeoberfläche ca. 15 m zur Donau hin abfiel, hatten diese Schutzrohre auch das Ziel Spülungsausbrüche an der Oberfläche zu vermeiden.

Bild 01: Rohrbautrasse

Parallel dazu fand eine Baugrunduntersuchungskampagne statt, die die gesamte Bohrtrasse für beide Bohrungen abdeckte. Diese sah zunächst 10 Kernbohrungen in Tiefen von bis zu 100 m vor, die Grundlage für eine umfangreiche geophysikalische Bodenuntersuchung war, mit der Schichtenverläufe und –grenzen erkannt werden sollten. Das Resultat, bzw. die Aussage dieser Kampagne war ungünstig: man hatte es tatsächlich geschafft, die Bohrungen an die gefühlt geologisch ungünstigste Örtlichkeit zu legen. Dies konnte auch nicht mehr geändert werden, da die Anschlussstationen auf der bulgarischen und rumänischen Seite bereits gebaut waren. Der Baugrund auf der bulgarischen Startseite war großflächig von tektonischen Störzonen mit geringen Abständen zueinander durchsetzt. Der Rest der Bohrtrasse erwies sich auch nicht als viel besser, außer als dass die Häufigkeit der dann bekannten Störzonen sich von 5 Störzonen auf den ersten 200 m Bohrstrecke auf 10 weitere Störzonen auf den verbleibenden 1900 m Bohrstrecke reduzierten. Ansonsten war klar, dass mehr oder weniger klüftiger Kalkstein mit einaxialen Druckfestigkeiten zwischen 30 und 160 MPa (hart wie Porzellan) zu durchfahren war. Mit diesen Voraussetzungen ging LMR dann also ins Rennen.
Erwartungsgemäß klappte der Schutzrohreinbau gut und konnte nach 5 Wochen für beide Bohrungen abgeschlossen werden.

Bild 02: Bohrplatz HDD 1 Blick von Osten nach Westen

Dem folgte der Aufbau der HDD Bohrausrüstung und am 2. Juli 2016 wurde der Bohrbetrieb aufgenommen. Bald darauf wurde die erste Störzone angebohrt und, nicht ganz überraschend, stellten sich augenblicklich totale Spülungsverluste ein. Die Geschwindigkeit, mit der die Bohrspülung weglief, war allerdings für das Fachpersonal auf der Baustelle überraschend, sodass sich der Eindruck ergab, eine Vakuumblase angebohrt zu haben, die innerhalb weniger Sekunden mehr als 60 m³ Spülung schluckte. Der nächste Monat war geprägt von Zementationen, mit denen diese Stör- und Verlustzonen abgedichtet, bzw. verfüllt wurden. Dabei wurde auf Zementationstechnik aus dem Ölfeld zurückgegriffen. Zusätzlich wurden neuartige Zementrezepturen auf der Baustelle entwickelt, die ein immer effizienteres Vorgehen beim Dichtsetzen ermöglichten. Gleichzeitig wurde die Pilotbohrung vorangetrieben. Die Häufigkeit der Zementationen bestätigte negative Prognosen der Baugrunduntersuchungen, dass trotz des Verpumpens großer Volumina an Dicht- und Füllmaterial, extrem hohe Durchlässigkeiten bzw. große Kluftweiten im Baugrund angetroffen wurden, die wahrscheinlich in Verbindung mit fließendem Grundwasser zu einem schnellen Abtransport des Dicht- und Füllmaterials führten. Da diese Häufigkeit der Zementationen für alle Beteiligten überraschend war und diese eine unerwünschte Verzögerung der Bauzeit nach sich zogen, begannen nach 2 Wochen erste Überlegungen, wie man die beiden Bohrungen in der vorgegeben Zeit (vor Wintereinbruch) fertigstellen könnte. Ende Juli waren 38 % der ersten Pilotbohrung fertig, dazu wurden aber bereits 115 % der dafür zur Verfügung stehenden Bauzeit genutzt. Guter Rat war teuer, Überlegungen gingen ergebnisoffen in alle Richtungen. Der Bauherr und die Baufirmen standen mit dem Rücken zur Wand, da die vorstehende Bauzeitenanalyse und eine entsprechende Extrapolation des Zeitstrahls deutlich zeigten, dass, wenn überhaupt, nur die erste Bohrung bis Weihnachten 2016 fertig gestellt werden würde. Das hätte dann die Kofinanzierung durch die EU zumindest in Frage gestellt.

Bild 03: Bohrplatz HDD 1 Blick von Westen nach Osten

Letztendlich wurde gemeinsam mit dem HU und dem Bauherren die Entscheidung getroffen, die Bohrung zur Not auch mit vollen Spülungsverlusten durchzuführen. Dazu wurde einiges an zusätzlicher Spezialausrüstung von LMR mobilisiert. Um sicherzustellen, dass der Endtermin gehalten werden konnte, wurde außerdem beschlossen, die Bohrarbeiten mehrschichtig im 24 Std. Betrieb an 7 Tagen die Woche fortzusetzen. Damit gelang es dann, die erste Pilotbohrung am 27. August um 23:28 Uhr fertig zu stellen. Das war für alle Beteiligten eine große Erleichterung, da zwischenzeitlich und insbesondere zum Ende der Pilotbohrung extrem hohe Drehmomente (> 80 KNm) und Druckkräfte (> 900 KN) erforderlich waren, die nur durch LMRs überschweres Bohrgestänge handhabbar waren, um die Pilotbohrung zu einem glücklichen Ende zu führen, um nicht zu sagen, den Piloten durchzuprügeln.

Anschließend begann die Aufweitung des Bohrloches. Diese musste aber bald abgebrochen werden, da auf den ersten 10 Bohrstangen (von 215) die Drehmomente dauerhaft im Überlastbereich > 90 KNm lagen. Ein hydraulischer Drehmotor der Bohranlage ging dabei zu Bruch. Um weiteren Schaden abzuwenden wurde auf der Baustelle der defekte Motor von der Bohrmannschaft repariert und modifiziert. Zusätzlich fand eine Befahrung des Bohrloches mit einem speziell auf diese Bedürfnisse zugeschnittenen, von LMR entwickelten Bohrwerkzeug statt, das darauf abzielte, die am Bohrstrang aufgetretenen Kräfte zu reduzieren. Nach dieser Bohrlochbefahrung (Check Trip) konnte das Bohrloch erfolgreich aufgeweitet werden. Das Aufweiten des Bohrloches war ein verhältnismäßig aufreibender Vorgang, da das Bohrgestänge eine 2100 m lange Antriebswelle für das Aufweitwerkzeug, einen Hole-Opener, darstellt. Die Handhabung der Bohrgarnitur durch die Geräteführer war eine schwierige Aufgabe, da der Bohrstrang über solche Längen dazu neigt, sich mehrfach zu verdrillen, bevor das Bohrwerkzeug, ein -Opener, auf der Bohrlochsohle überhaupt beginnt zu arbeiten. Gleichzeitig kommt bei Felsbohrungen die Besonderheit dazu, dass solche Werkzeuge gelegentlich haken, also nicht rund, sondern eher ungleichmäßig laufen. Das damit einhergehende Risiko sind Gestängebrüche und das Lösen von verschraubten Verbindungen, die dann zeitaufwendige Bergungs- oder Ret-

tungsarbeiten nach sich ziehen. Zu einem Gestängebruch kam es beim Aufweiten nicht, wohl aber stellte sich die Situation ein, dass sich einmal der Bohrstrang im Bohrloch, bedingt durch den „Slip-Stick-Effekt“, entschraubte. Glücklicherweise gelang es sofort, die Bohrstränge wieder zu verbinden, was dem besonnenen und weitsichtigen Agieren des Bohrgeräteführers geschuldet war. Durch ein anschließendes Nachverkontern des Bohrstrangs konnte die Aufweitung des ersten Bohrloches erfolgreich abgeschlossen werden.

Bild 04: Hole-Opener nach Aufweiten HDD 1

Dem Aufweiten folgten ein Checktrip und eine weitere Befahrung des Bohrloches mit einem Dummy. Der Dummy sollte sicherstellen, bzw. simulieren, dass das eingesetzte Korrosionsschutzumhüllungssystem den Kräften im Bohrloch, die auf das einzuziehende Produktrohr wirken, widersteht. Die Notwendigkeit für den „Dummyrun“ ergab sich, da das Produktrohr für die erste Bohrung bereits 3 Jahre ungeschützt auf der Rohrtrasse mit einer GFK Umhüllung vorgefertigt lag. Tests im Sommer 2016 hatten gezeigt, dass zumindest Teile dieser Isolierung reparaturbedürftig waren. Der Dummyrun zeigte signifikante Schäden an der Isolierung. Trotz dieser negativen Warnzeichen wurde das erste Produktrohr in Absprache und nach Aufforderung durch den Bauherren erfolgreich eingezogen. Eine anschließende Intensivmessung zeigte keine Isolierschäden, was mit großer Erleichterung aufgenommen wurde.

Bild 05: Austrittspunkt Rohreinzug HDD 1

Während der Aufweitung des Bohrloches wurde mit dem Hintergrund des sich nähernden Winters mit dem HU und dem AG besprochen, was auf der zweiten Bohrung unternommen werden konnte, um diese schneller und sicherer auszuführen. Aus diesen Gesprächen resultierte ein angepasstes neues Bohrkonzept.

Das sah zusammengefasst vor:

1. Die Verwendung modifizierter Bohrgarnituren und -programme,
2. die Strecke, auf denen Zementationen durchgeführt werden sollten, zu reduzieren,
3. die Pilotbohrarbeiten mit 2 Bohranlagen auf der Basis eines „Meeting in the Middle“ zu machen und Spülungsverluste, wenn sie denn auftreten würden, hinzunehmen,
4. frühest möglich auf der Basis von 24 h an 7 Tagen zu arbeiten.

Dem ersten Rohreinzug folgte ein berauschendes Rohrfest und das Umsetzen der Bohranlage, bzw. der parallele Aufbau der zweiten Bohranlage auf der rumänischen Baustelle bei Comasca.
Dann ging die Pilotbohrung los. Diese verlief auf der rumänischen Seite weitgehend frei von Problemen, bis schließlich bei ca. 1400 m Bohrstrecke gestoppt wurde, um auf den von Bulgarien kommenden „Piloten“ zu warten. Die von Bulgarien kommende Pilotbohrung verlief zunächst auch wesentlich besser als geplant. Es war lediglich eine Zementation (im Vergleich zu > 8 auf HDD 1) erforderlich. Dann wurde ungewollt nach ca. 400 m Bohrstrecke die Bohrgarnitur stark abgelenkt. Die dort angetroffenen, unvorteilhaft zur Bohrlinie verlaufenden, lokal stark karstigen und stark wechselhaft harten Formationen („Felslasagne“), machten eine zeitaufwendige Korrektur der Bohrlinie erforderlich. Nach mehreren Tagen war das geschafft und dann konnte bis hin zum „rumänischen Piloten“ gebohrt werden; das „Meeting“ fand statt. Dabei passierte zunächst der bulgarische Pilot den rumänischen Piloten. Mit Hilfe spezieller Bohrlochvermessungswerkzeuge konnte der Abstand der beiden Bohrlochvermessungssonden zueinander ermittelt werden. Darauf basierend wurden Kurskorrekturen berechnet, die Pilotbohrung fortgesetzt, der vorstehende Vorgang mehrfach wiederholt, bis schließlich der bulgarische Pilot in das Bohrloch des rumänischen Piloten unter Einhaltung elastischer Biegeradien des Produktrohrs für den Lastfall Druckprobe eintrat. Danach wurde der rumänische Pilot rasch ausgebaut und der bulgarische Pilot hinterher geschoben. Das klappte hervorragend – bis 8 Bohrstangen vor Austritt auf der rumänischen Seite der Pilotmeißel den Bohrkanal ins weiche Erdreich verließ. Obwohl das in spülbaren, weichen Böden geschah, gelang es mit der zu diesem Zeitpunkt montierten Felsbohrgarnitur, zielorientiert den rumänischen Austrittsunkt zu erreichen. Die damit verbundene „Notaktion“ war nicht geplant, führte aber im Sinne von „der Zweck heiligt die Mittel“ zum Ziel.

Nach dem schließlich erfolgreichen Ende der Pilotbohrarbeiten fand das Aufweiten des Bohrloches statt. Mit den Erfahrungen, die auf der ersten Bohrung gesammelt wurden, war die Zielsetzung erneut, ein Auftreten von hohen Drehmomenten am Bohrstrang zu vermeiden. Um dieses Ziel umzusetzen, wurde die auf der rumänischen Seite der Baustelle stehende Bohranlage durch LMR modifiziert, so dass beide Bohranlagen den im Bohrloch befindlichen Bohrstrang gemeinsam rotieren und ziehen, bzw. schieben konnten. Mit dieser Verfahrensänderung konnten die am Bohrstrang wirkenden Drehmomente von 90 – 100 KNm (HDD 1) auf 10 – 65 KNm (HDD 2) reduziert werden. Der

Bohrfortschritt beim Aufweiten des Bohrloches konnte damit signifikant verbessert werden. Das Aufweiten des zweiten Bohrloches nahm 10 Tage in Anspruch und war damit im Bereich der ursprünglich kalkulierten Ansätze. Trotz der beim Pilotbohren angetroffenen Verlustzonen gelang es mit einer speziellen Spülungskonfiguration und -konditionierung, den Spülungsrückfluss beim Aufweiten des Bohrloches über fast 1800 m aufrecht zu erhalten – in dieser Hinsicht gilt ein großes Lob an die Spülungsingenieure und das Team auf dem Mischtanks, die diese Bohrung betreut haben.

Nach dem Aufweiten des Bohrloches wurde ein Checktrip durchgeführt. Dieser diente dazu, sicherzustellen, dass das Bohrloch frei von Hindernissen ist. Der Checktrip wurde außerdem genutzt, um einen Abgleich der auf den Bohrstrang wirkenden Kräfte während der Pilotbohrung und des Aufweitens zu machen. Diese Kräfte wurden auch mit den Werten der ersten Bohrung verglichen. Mit dem Checktrip konnte die gute Qualität des Bohrloches bestätigt werden und der Rohreinzug konnte anschließend mit großem Erfolg innerhalb von 18 ½ Stunden durchgeführt werden. So war dann schließlich das zweite Rohr am 04. November um 17:38 Uhr lokaler Zeit eingezogen, deutlich vor dem Beginn des Winters und zur großen Freude der Bauherren, des Hauptunternehmers – und um ehrlich zu sein – auch zur großen Erleichterung von LMR.

Fazit:
Für LMR war diese Baumaßnahme die erste HDD Großbaustelle auf dem Balkan. Nicht überraschend ist, dass in Bulgarien und Rumänien einige Lösungsansätze und Handlungsweisen anders laufen als in Westeuropa. Positiv überraschend waren die hohe Motivation und die Eigeninitiative, die lokale Partnerunternehmen zeigten. Insbesondere die Unterstützung durch lokale Behörden war sehr positiv. Wichtig für LMR war, nie die Hoffnung aufzugeben und sich permanent der Frage zu stellen; was man jetzt noch verbessern kann und dies im offenen Gedankenaustausch mit dem AG und dem HU zu kommunizieren. In diesem Zusammenhang haben sich alle Änderungen des Bohrprogramms und der Bohrausrüstung als richtig und gut erwiesen.

Bild 06: Rohreinzug

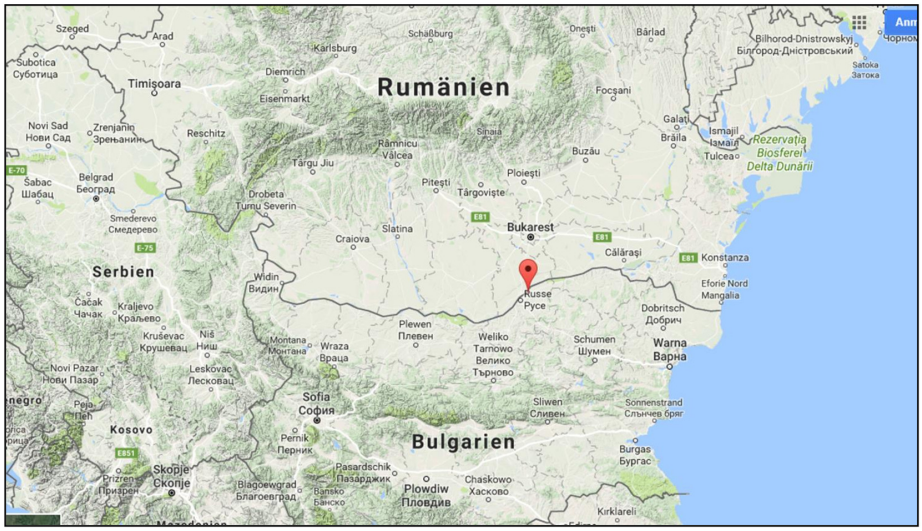
Projekt: Donaukreuzungen – Interconnector
Planung HDD: LMR Drilling GmbH
Auftraggeber: Bulgartransgaz + Transgaz Romania
Hauptunternehmer: HABAU PPS Romania (im Konsortium mit Fa. INSPET)
Auftragnehmer (HDD): LMR Drilling GmbH
Subunternehmer: Prime Horizontal für Bohrlochvermessung beim Intercept, HEADS für Bohrspülung
Ausführungszeitraum: Juni 2016 – November 2016
Beteiligte Mitarbeiter: das komplette LMR Team
Geräteeinsatz: Bohranlagen 3500.180.1 und 2500.120.3 mit kompletter doppelter Bohrausrüstung und 3000 m Bohrgestänge

HDD-Kreuzung der Donau
Erdgas-Interconnector Rumänien – Bulgarien
Ausführung der Bohrarbeiten (Teil2)

HDD-Crossing of River Danube
Gas Interconnector Romania – Bulgaria
Drilling Operations (part 2)

Author: Dipl.-Ing Ernst Fengler, LMR Drilling GmbH
Presented by: Dipl.-Berg-Ing. Günter Kruse, LMR Drilling GmbH

1. Project Description
2. Project Parameters
3. What made the project special
4. How were tasks tackled
5. Lessons learned



Lokation HDD Giurgiu / Ruse
Location HDD Giurgiu / Ruse

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Projekt Geschichte – Project History:

Erste Ausschreibung: First tender:	2012
Vergabe/Award:	Lokales Unternehmen / local contractor
Abbruch/cancellation:	2014
Ursache/reason:	Mangelhafter Baufortschritt, Erfolgschancen erschienen unsicher poor drilling progress, chances for success appeared being not certain
Weitere Ausschreibungen/ Further tenders:	2015/2016
Letztendlicher Gewinner der Ausschreibungen/ Final winner on the bidding process:	INSPET Ploiesti + HABAU PPS

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Projekt Parameter:

Länge/length:	
geplant/design:	2 x 2100 m
ausgeführt/as-built:	2096,49 m + 2090,53
Rohr/pipe:	20" steel pipeline DN 500 (508 x 10 mm) L360MB with 5 mm PE coating and 5 mm reinforced glass-fibre coating. (1 of 2 strings built in 2012)
Design Tasks:	1) stay way from drill lines of previous contractor
Planungsziele:	2) avoid karstic zones to known extent
	3) cross instable layers over shortest possible distance
	4) have a programme for mud losses
	5) have a programme for instable soils
	6) use most robust drill tools/-equipment
	7) infrastructure – mud transfer
	8) infrastructure – implementation of back up solutions

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Herausforderungen/Challenges:

1. Client:	schlechte Erfahrung mit HDD auf diesem Projekt bad HDD experience on this same project
2. Hauptunternehmer: Main Contractor:	keine Erfahrung mit HDD Großbohrtechnik local team had not done large scale HDD projects to date
3. Bauflächen: Construction Areas:	Rigseite eigentlich zu klein, Pipeseite eigentlich zu kurz rig site too small, pipe site too short
4. Geologie: Geology:	Baugrunduntersuchungen fanden begleitend zu den HDD-Arbeiten statt, nicht davor (praktisch 2 Monate zu spät). Soil investigations took place parallel to ongoing HDD operations, not before (actually 2 months too late).
5. Oberflächen: Surfaces:	Gelände fällt steil 15 m zur Donau ab, 100 m vom Eintrittspunkt und auf der Rohrbautrasse, Bohrtrasse ist zu 98% Naturschutzgebiet. Surface drops off 15 m (100 m from entry point) and on welding trace; drill alignment is 98% Natura 2000 area

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Freundschaftsbrücke
Friendship Bridge

1. Project Description
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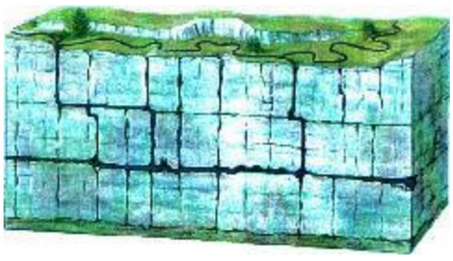
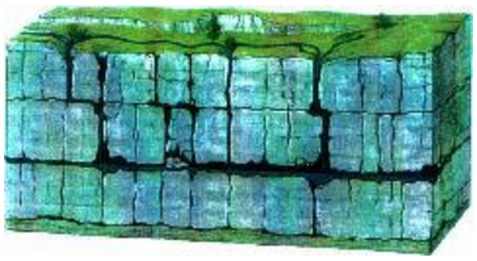
Karst – Was ist das?



Ein Bach läuft noch oberirdisch ab. Durch Erdbewegungen entstehen Risse im Kalkstein.

A small stream floats along surface. Related to earth movements fissures/cracks appear in lime stone.

Karst – what is that?



Kohlensäurehaltiges Wasser dringt in den Boden ein, und mit diesem Wasser beginnt die Kalklösung.

Carbonated water enters the fissures/cracks and this water starts the disolution of the lime stone.

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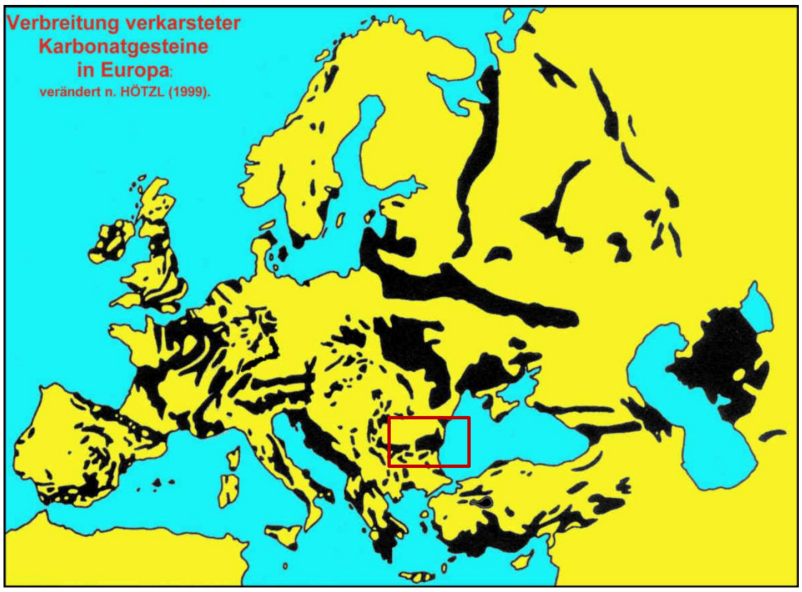
Occurance of karstic lime stone formations in Europe



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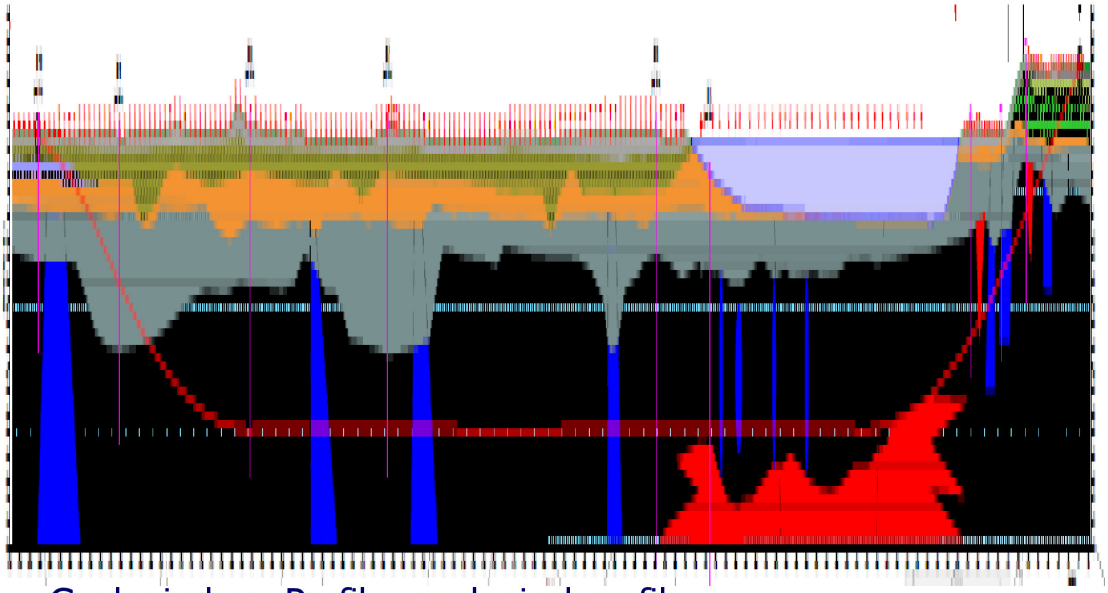

Geologisches Profil – geological profile

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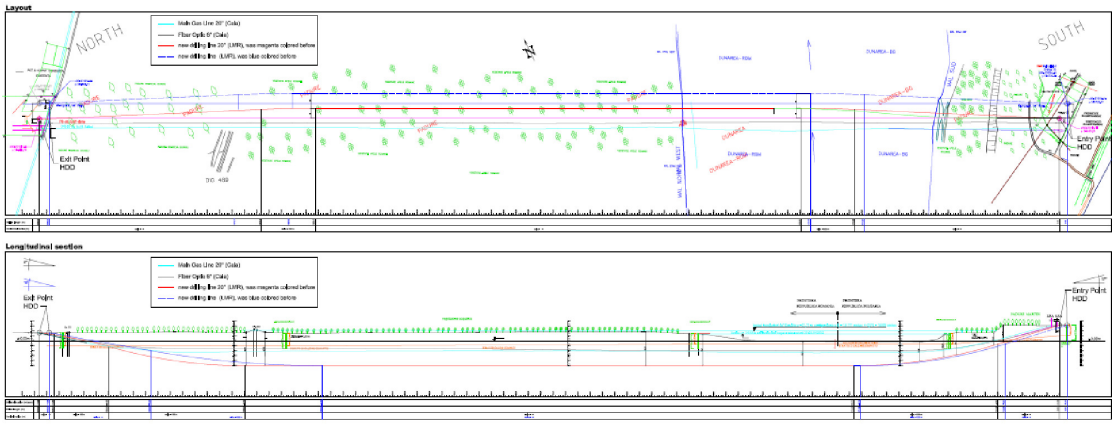

Entwurf der Bohrprofile - design of drill alignments

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Ausführung HDD 1 / Execution HDD 1:

DN 800 Casing auf den ersten 120 m
32" Casing on first 120 m

12 1/4" Pilot Bit TCI + Mud Motor
Magnetic Steering Tool

Zementationen mit offenem Gestänge
Cementations with open Drill Pipe

26" Hole Opener TCI

1. Project Description
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Entry Point Casing DN 800 mm Installation

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Entry Point Casing DN 800 mm Installation

Drilling Contractors Association (DCA-Europe) Topic: „HDD First"

1. Project Description
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Pilotbohren / Pilot drilling BHA:

12 1/2" HDX TCI Tricone Bit

8" Mud Motor 1,83° 6/7 Lobe 5.0 Stage

PWD Sub

1 x 8" NMDC mit Steering Probe
1 x 8" NMDC

100 x 6 5/8" DP

100 x 7 5/8" DP

1. Project Description
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Zementationen: Bei starken/totalen Spülungsverlusten
Cementing operations: Upon severe/total Mud Losses

Ausbau der Pilot-Bohrgarnitur
POOH Pilot BHA

Einbau offenes Bohrgestänge
RIH open Drill Pipe String

Aktivierung Ölfeld-Zement-Ausrüstung + Silotrucks
Activation of oil field cementing pump truck and silo trucks

Zement pumpen und Spülung hinterher
Pump Cement and Displacement

Ausbau/ POOH

Aushärten lassen 12-24 h
Wait for cement to harden 12-24 hrs

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Zementationsbereichen - Areas of Cementations on HDD1

Date	Section	Volume
26.07.2016	120 - 165 m	31,0 m³
27.07.2016	120 – 165 m	70,5 m³
30.07.2016	120 – 165 m	76,5 m³
31.07.2016	120 – 165 m	72,5 m³
04.08.2016	330 m	51,0 m³
08.08.2016	450 m	37,0 m³
17.08.2016	591 m	124,0 m³
18.08.2016	591 m	124,0 m³
	Total:	586,5 m³

=>Entscheidung: ohne Zementationen die Pilotbohrung fortsetzen
=>Decision to continue pilot drilling without further cementations

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Austritt Pilotbohrung 1
Punch Out Pilot HDD 1

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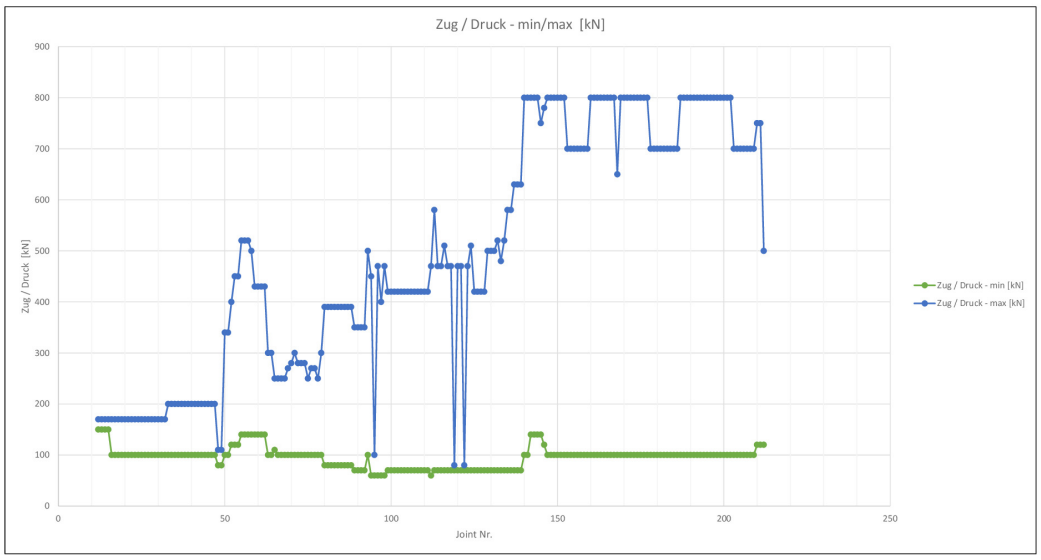
Pilot HDD1 – Push Force



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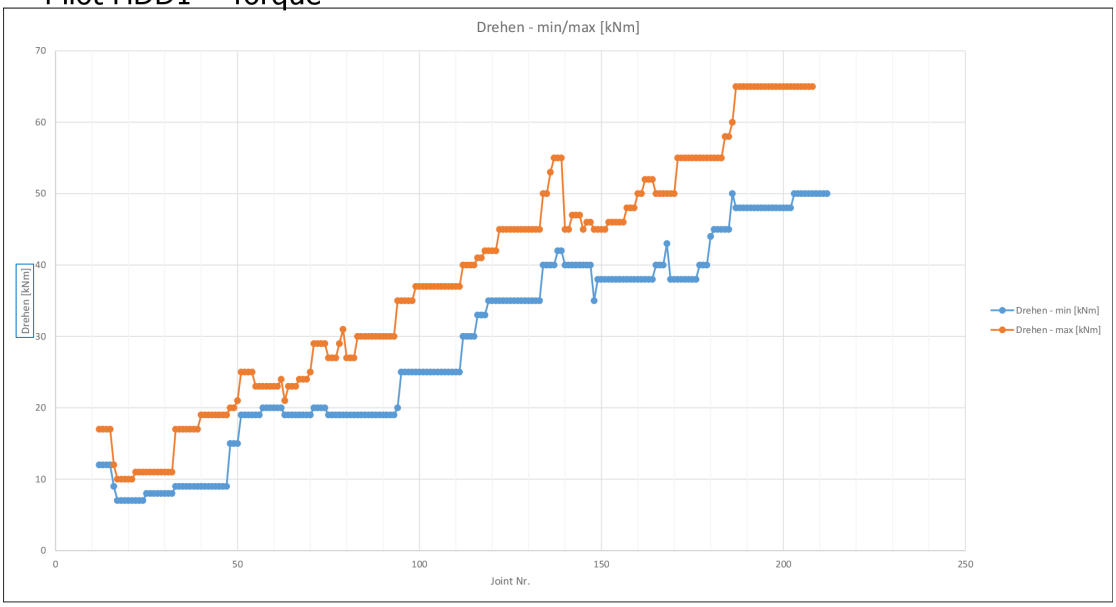
Pilot HDD1 – Torque



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Aufweiten / Reaming 26" = 660 mm
BHA:

Surface Bulgaria
7 5/8" DPs
6 5/8" DPs
Float sub
26" HDX hole opener (5 cutter from 16" HDX)
Float sub
DPs

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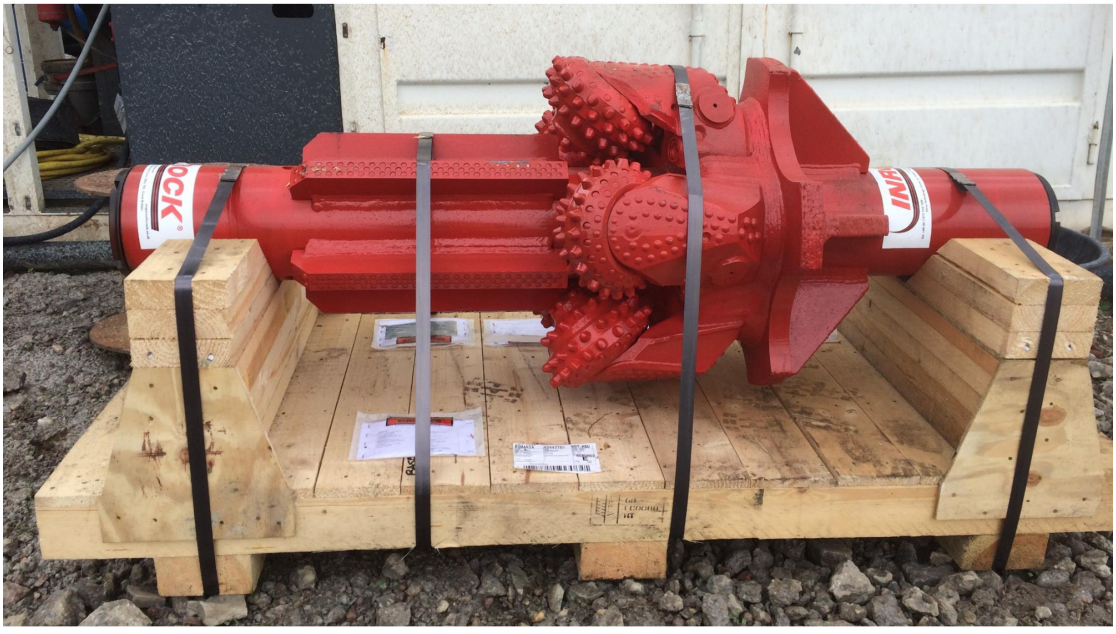

Drilling Contractors Association (DCA-Europe) Topic: „HDD First"

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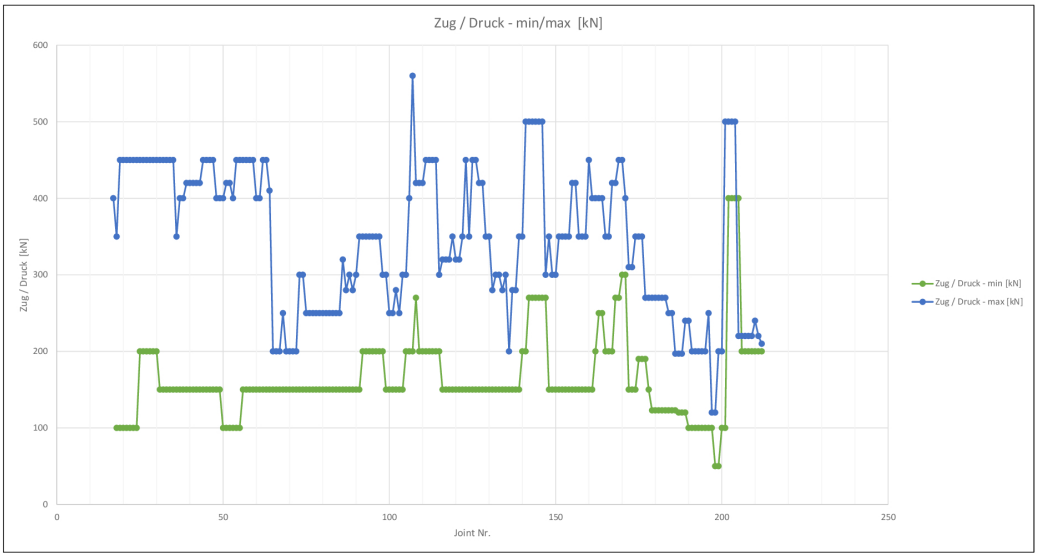
26" Reaming HDD1 – Pull Force



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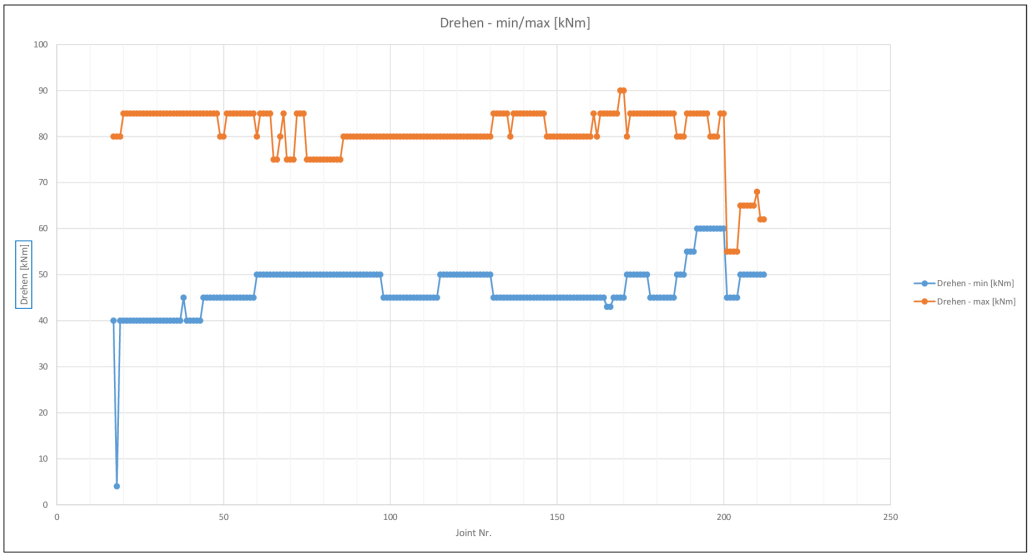
3. What made the project special
4. How were tasks tackled
5. Lessons learned

26" Reaming – Torque HDD1



1. Project Description
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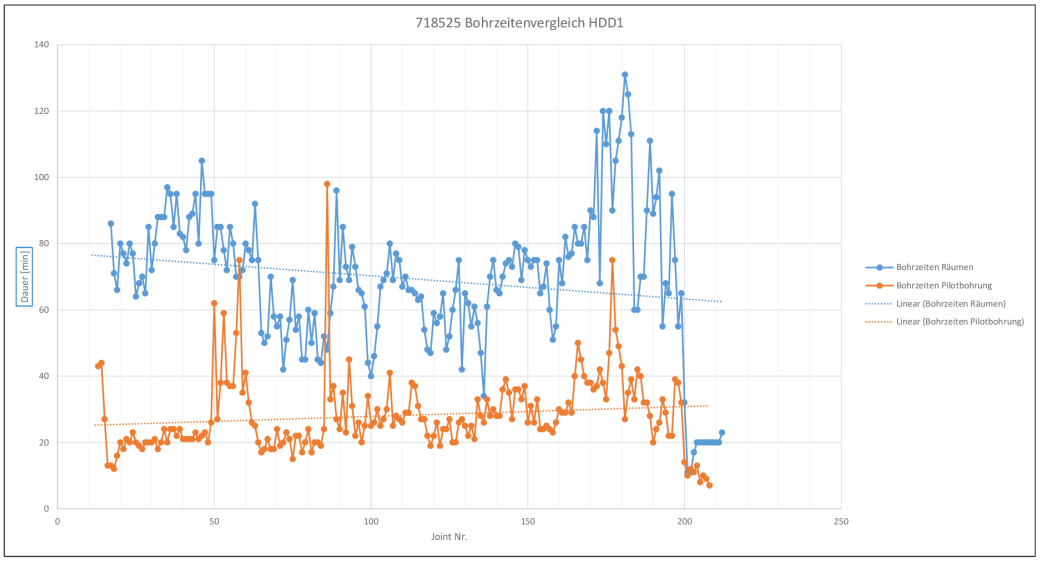
Drilling Time HDD1 – Pilot/Reaming



1. Project Description
2. Project Parameters
3. What made the project special
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Ausführung / Execution HDD 2 (new program):

Two HDD Rigs → Meeting in the Middle

DN 800 Casing auf den ersten 120 m in Bulgarien
32" Casing on first 120 m in Bulgaria

Temporäres 13 3/8" Casing in Rumänien
Temporary 13 3/8" Casing installed in Romania

14 3/4" Pilot Bit TCI + Mud Motor
Magnetic Steering Tool

Zementationen bis maximal 400m in Bulgarien
Cementations limited to 400m in Bulgaria

26" Hole Opener HDX pull reaming

1. Project Description
2. Project Parameters
3. What made the project special
4. How were tasks tackled
5. Lessons learned

HDD 2: Pilotbohren / Pilot drilling BHA:

14 – 3/4" HDX Tricone Bits with 3 x 22/32" nozzles

Rotating Magnet Sub

8" Mud Motor 1,83° 6/7 Lobe 5.0 Stage

PWD Sub

1 x 8" NMDC mit Steering Probe
1 x 8" NMDC

140 x 6 5/8" DP (Romania)
80 x 7 5/8" DP (Bulgaria)

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1. Project Description
2. Project Parameters
3. What made the project special
4. How were tasks tackled
5. Lessons learned

HDD 2: Aufweiten - Reaming 26" = 660 mm BHA:

Surface Bulgaria
7 5/8" DP
6 5/8" DP
Float sub
26" HDX hole opener
Float sub
DP

1. Project Description
2. Project Parameters
3. What made the project special
4. How were tasks tackled
5. Lessons learned

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1. Project Description
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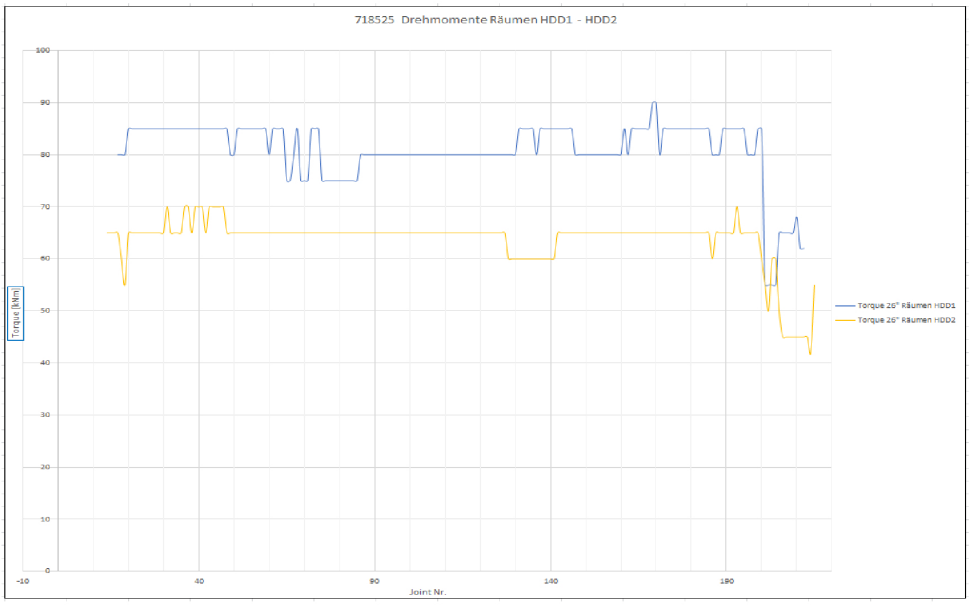
26“ Reaming - Torque HDD1 / HDD2



1. Project Description
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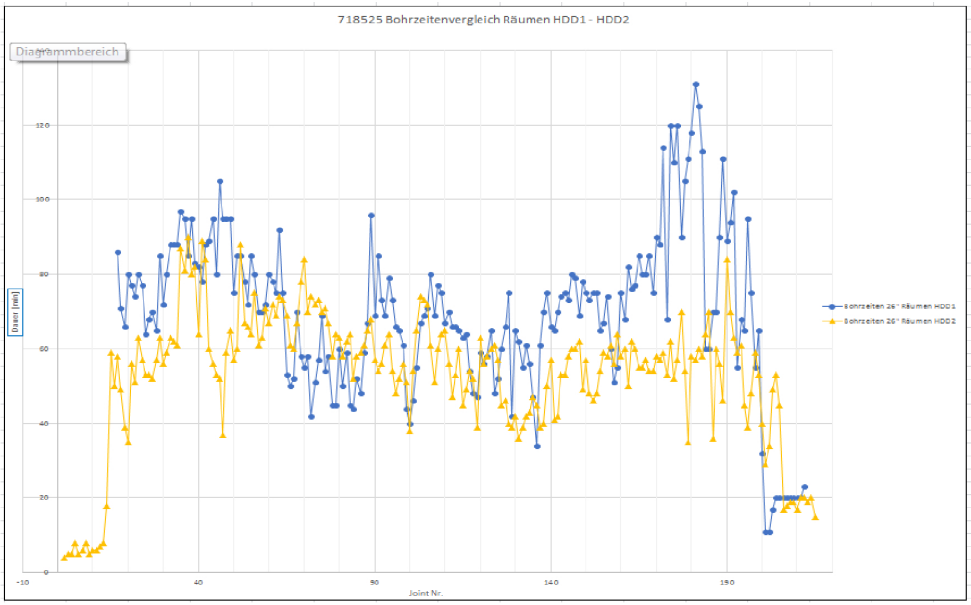
26" Reaming – Drilling Time HDD1 / HDD2



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1. Project Description
2. Project Parameters
3. What made the project special
4. How were tasks tackled
5. Lessons learned

Erfahrungen:

1. Eine gute Planung ist Gold wert
2. Zementationen können Karst abdichten, allerdings nicht in allen Fällen
3. Eine gute Bohrlochreinigung erleichtert das Einziehen
4. Ruhe bewahren, dann wird alles gut

Lessons learned:

1. A good design is worth gold
2. Cementing works, but not necessarily under all circumstances
3. Good hole cleaning eases the pull back
4. Keep calm, eventually everything will be alright

➔ Impressionen

1. Project Description
2. Project Parameters
3. What made the project special
4. How were tasks tackled
5. Lessons learned

Baustellen Impressionen / Site Impressions:

1. Project Description
2. Project Parameters
3. What made the project special
4. How were tasks tackled
5. Lessons learned

Baustellen Impressionen / Site Impressions:

1. Project Description
2. Project Parameters
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Baustellen Impressionen / Site Impressions:

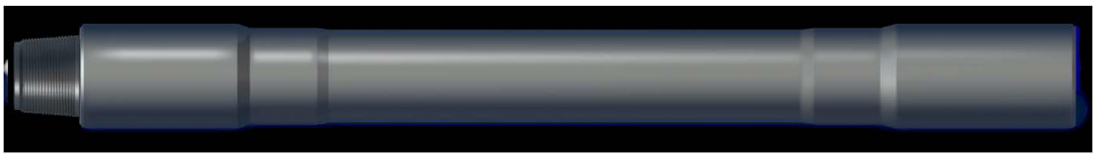
TIGER TRADING, INC.

HDD TUBULAR PRODUCTS

"What you always wanted to know about drill pipe but were afraid to ask!"

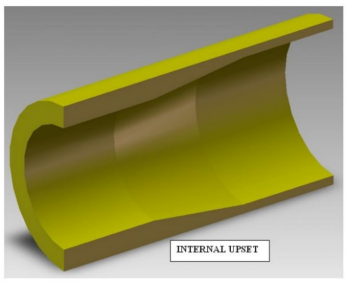
TABLE OF CONTENTS

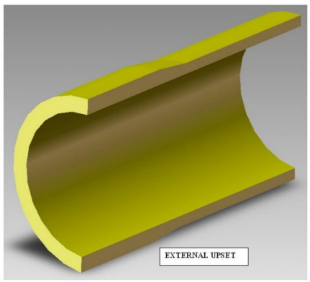
INTRODUCTION TO LARGE DIAMETER DRILL PIPE

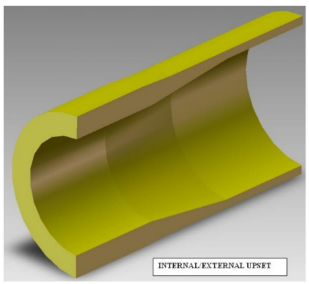


- A drill pipe joint consists of a Pin and a Box Tool Joint that are friction welded to a mid body tube.
- Large diameter drill pipe vary in sizes from 3-1/2" OD to 8-5/8" OD with the tool joints varying from 4-1/8" OD to 8-3/4" OD, respectively.
- Typically large diameter drill pipe is manufactured in 31.5' (9.6M) lengths which is referred to as R2 per API Specifications 5DP.
- Custom lengths such as 6M length drill pipe can be manufactured to Customer spec.
- All oilfield drill pipe is manufactured to API Specifications for example Spec 5DP.

MID BODY TUBE SPECIFICATIONS







- The pipe mid body tube is forged and heat treated to meet the customer specifications.
- Drill pipe can either be Upset with an Internal Upset (IU), External Upset (EU), or Internal External Upset (IEU).
- Depending on the pipe grade the upset type shall be specified to meet the welding parameters needed to give the product the most strength.

MID BODY TUBE SPECIFICATIONS

PIPE GRADE		E-75	X-95	G-105	S-135
YIELD STRENGTH (PSI)	MIN	75,000	95,000	105,000	135,000
	MAX	105,000	125,000	135,000	165,000
TENSILE STRENGTH (PSI)	MIN	100,000	105,000	115,000	145,000

- API drill pipe grade types are E-75, X-95, G-105, and S-135.
- The pipe mid body tube is heat treated after upsetting, to provide the mechanical properties needed to meet specified specs.
- For the HDD market Grade S-135 is predominately used for all drill pipe.
- Drill pipe cost structure is approximately 30% for the tool joints, 40% for the tube and all processing is 30% for weld, finish, and final.

MID BODY TUBE SPECIFICATIONS

Size OD	Nominal Weight	Upset Type	Grade	Torsional Yield Strength	Tensile Yield Strength	Wall Thickness	Nominal ID	Connection Type	Outside Diameter	Inside Diameter	Torsional Yield Strength	Tensile Yield Strength	Make-up Torque
in.	lbs/ft			ft-lb	lb	in.	in.		in.	in.	ft-lb	lb	ft-lb
3 1/2	13.30	EU	S	33,400	488,800	0.368	2.764	NC38	5	2 7/16	22,200	708,100	11,700
3 1/2	15.50	EU	S	38,000	581,000	0.449	2.602	NC38	5	2 1/8	26,500	842,400	14,000
4 1/2	16.60	IEU	S	55,500	595,000	0.337	3.826	NC46	6 1/4	2 3/4	44,900	1,183,900	23,200
4 1/2	20.00	IEU	S	66,400	742,200	0.430	3.640	NC46	6 5/8	2 1/2	50,400	1,307,600	25,600
5	19.50	IEU	S	74,100	712,100	0.362	4.276	NC50	6 5/8	2 3/4	63,400	1,551,700	32,900
5	25.60	IEU	S	94,100	954,300	0.500	4.000	NC50	6 5/8	2 3/4	63,400	1,551,700	32,900
5 1/2	21.90	IEU	S	91,300	786,800	0.361	4.778	5-1/2 FH	7 1/2	3	87,200	1,925,500	44,600
5 1/2	24.70	IEU	S	101,800	895,000	0.415	4.670	5-1/2 FH	7 1/2	3	87,200	1,925,500	44,600
6 5/8	25.20	IEU	S	127,000	881,000	0.330	5.965	6-5/8 FH	8 1/2	4 1/4	109,200	2,102,300	56,100
6 5/8	27.70	IEU	S	137,300	961,600	0.362	5.901	6-5/8 FH	8 1/2	4 1/4	109,200	2,102,300	56,100
7 5/8	33.70	IEU	S	214,900	1,312,100	0.430	6.765	6-5/8 FHDS	8 1/2	4 1/4	170,700	2,278,000	102,400
8 5/8	44.00	IEU	S	318,300	1,723,000	0.500	7.625	6-5/8 FHDS	8 3/4	4	178,500	2,297,100	105,900

- Drill pipe varies not only in size but also in weight.
- Same size OD can have different weights.
- When ordering specify by nominal weight, BUT when shipping ask the manufacture to specify the "Adjusted Weight".
- The "Adjusted Weight" will vary based on Tool Joint Connection geometry.

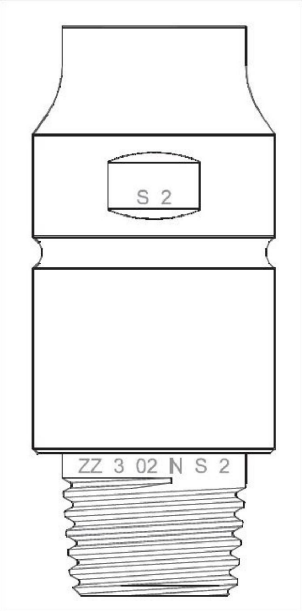
MID BODY TUBE SPECIFICATIONS (Metric)

Size OD	Nominal Weight	Upset Type	Grade	Torsional Yield Strength	Tensile Yield Strength	Wall Thickness	Nominal ID	Connection Type	Outside Diameter	Inside Diameter	Torsional Yield Strength	Tensile Yield Strength	Make-up Torque
mm	kg/m			N-m	kN	mm	mm		mm	mm	N-m	kN	N-m
88.90	19.79	EU	S	45,284	2,174	9.347	70.21	NC38	127.00	61.91	30,099	3,149.78	15,863
88.90	23.07	EU	S	51,521	2,584	11.405	66.09	NC38	127.00	53.98	35,929	3,747.18	18,981
114.30	24.70	IEU	S	75,248	2,647	8.560	97.18	NC46	158.75	69.85	60,876	5,266.25	31,455
114.30	29.76	IEU	S	90,026	3,301	10.922	92.46	NC46	168.28	63.50	68,333	5,816.49	34,709
127.00	29.02	IEU	S	100,466	3,168	9.195	108.61	NC50	168.28	69.85	85,959	6,902.30	44,606
127.00	38.10	IEU	S	127,582	4,245	12.700	101.60	NC50	168.28	69.85	85,959	6,902.30	44,606
139.70	32.59	IEU	S	123,786	3,500	9.169	121.36	5-1/2 FH	190.50	76.20	118,227	8,565.05	60,469
139.70	36.76	IEU	S	138,022	3,981	10.541	118.62	5-1/2 FH	190.50	76.20	118,227	8,565.05	60,469
168.28	37.50	IEU	S	172,189	3,919	8.382	151.51	6-5/8 FH	215.90	107.95	148,055	9,351.49	76,061
168.28	41.22	IEU	S	186,154	4,277	9.195	149.89	6-5/8 FH	215.90	107.95	148,055	9,351.49	76,061
193.68	50.15	IEU	S	291,365	5,837	10.922	171.83	6-5/8 FHDS	215.90	107.95	231,438	10,133.05	138,836
219.08	65.48	IEU	S	431,557	7,664	12.700	193.68	6-5/8 FHDS	222.25	101.60	242,014	10,218.01	143,581

MIDBODY TUBE CLASSIFICATION

- Drill pipe Classification types:
  - NEW
    - (Un-used drill pipe)
    - API – 87-1/2% Remaining Body Wall (RBW)
    - Industry – 95% RBW
  - PREMIUM – (DOUBLE WHITE BAND)
    - Tube OD wear is inspected to 80% RBW
    - Tool Joint OD wear acceptance criteria will vary on each connection
    - Tool Joint Tong Space Length Minimum for Breakout wrenches will vary on connection; typical 4" Pin and 6" Box
  - CLASS 2 – (YELLOW BAND)
    - Tube OD wear is inspected to 70% Remaining Body Wall RBW
    - Tool Joint OD wear acceptance criteria will vary on each connection
    - Tool Joint Tong Space Length Minimum for Breakout wrenches will vary on connection; typical 4" Pin and 6" Box
  - CLASS 3 – (RED BAND)
    - Any imperfections or damages exceeding Class 2 inspections

IDENTIFICATION MARKINGS



- Drill Pipe is visually identified by machined grooves and markings on the Pin Tool Joint OD.
- The ISO markings are being used to identify drill pipe grade, and weight.
- Pipe Weight Codes and Pipe Grade Codes are stamped on the pin landing.

Sample markings at base of pin[1,2]

1	2	3	4	5	6
ZZ	3	02	N	S	2

1 Tool Joint Manufacturer's Symbol:
ZZ Company (fictional for example only)

2 Month Welded:
3 – March

3 Year Welded
02 – 2002

4 Pipe Manufacturer's Symbol:
N – United States Steel Company

5 Drill Pipe Grade
S – Grade S135 drill pipe

6 Drill Pipe Weight Code[3]

Month and Year Welded

Month	Year
1 through 12	Last two digits of year

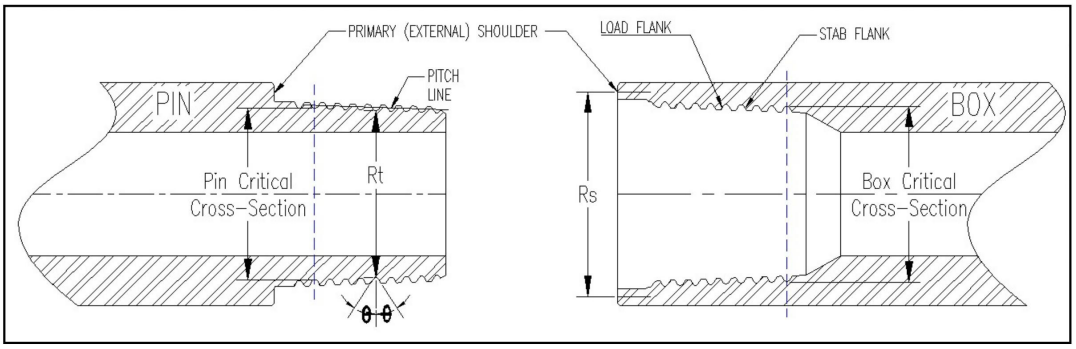
Drill Pipe Grade

Grade	Symbol
E75	E
X95	X
G105	G
S135	S

TOOL JOINTS

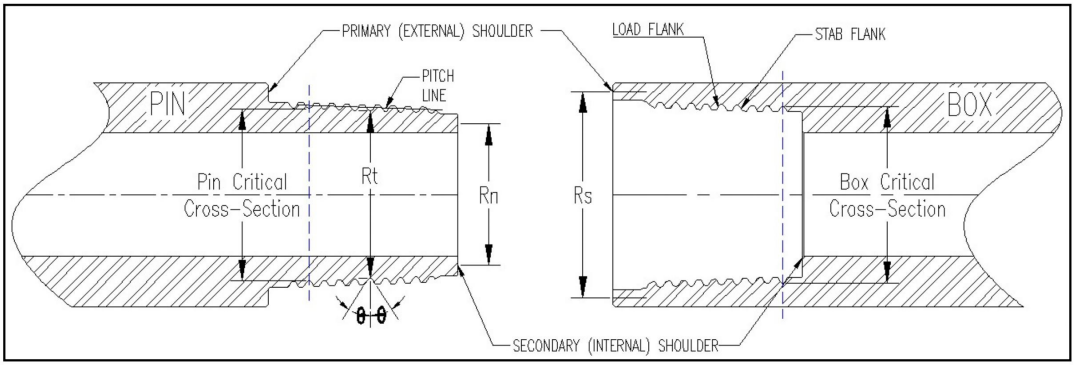
- Tool Joints consist of a Pin (Male) and Box (Female) Rotary Shoulder Connections.
- Tool Joints are typically made from AISI 4137M Steel Forgings, but can be made from AISI 4140/4145 bar stock material.
- Tool Joints are manufactured to API Spec 5DP & API Spec 7-2 specifications.
- Maintain a Minimum Specified Material Yield Strength (SMYS) of 120,000 psi.
- Industry are going to SMYS of 130,000 psi on Premium Rotary Shoulder Connections
- Three types of Rotary Shoulder Connections:
  - Single Shoulder
  - Double Shoulder
  - Premium Double Shoulder

SINGLE SHOULDER ROTARY CONNECTION



- Only has a Primary (External) Shoulder
- Low torsional capabilities
- Larger OD
- Smaller ID
- Examples of Single Shoulder Connections are NC (IF), FH, and Reg Connections

DOUBLE SHOULDER ROTARY CONNECTION



- Has two shoulders, a Primary (External) Shoulder and a Secondary (Internal) Shoulder
- High torsional capabilities
- Smaller OD
- Larger ID
- Examples of Double Shoulder Connections are NC-38 DS, 5-1/2 FH DS, 6-5/8 FH DS, DS77

A.P. FARR'S SIMPLIFIED SCREW JACK FORMULA

- A.P. Farr's Simplified Screw-Jack Formula for Determining Torsional Yield for Single Shoulder Rotary Connections

$$T = \frac{S_y A}{12}\left(\frac{p}{2\pi} + \frac{R_t f}{\cos\theta} + R_s f\right)$$

- Where:
  - T = Yield torque (ft-lbs)
  - S_y = Specified material yield strength (psi)
  - A = Area of pin critical cross-section or box critical-cross section depend on which is less.
  - *p* = pitch or lead of threads (in)
  - *f* = coefficient of friction on mating surfaces (assumed to be 0.08)
  - θ = ½ included angle of thread (º)
  - R_t = Average mean thread radius (in)
  - R_s = Average mean shoulder radius (in)

MAKE-UP TORQUE REQUIREMENT DETERMINATION

- Make-up Torque is defined as the torque needed to maintain the make-up shoulder(s) in contact to prevent any downhole make-up or shoulder separation from tensile and/or bending loads. Sometimes referred to as a pre-load.

- 60% of the Material Yield Strength has been determined to be sufficient in most connections but can vary based on the combined loading equation in API RP 7G.

- Make-up Torque Formula based on 60% of the Specified Material Yield Strength.

$$T = \frac{(0.60 S_y) A}{12}\left(\frac{p}{2\pi} + \frac{R_t f}{\cos\theta} + R_s f\right)$$

DRILLING THREAD COMPOUND USE

- The selection of a drilling thread compound is essential for the drilling application both for the life and performance of the tool joint connections as well as the environmental impact issues.
- Key points to consider are the environmental conditions of the wellbore where certain metals are unwanted, size of the drill pipe, and anticipated downhole temperatures.
- Thread compounds often contain a high percentage of lead, zinc, particles of Teflon (polytetrafluoroethylene), or molybdenum and graphite, the use of these thread compounds are prohibited in some areas.
- Using a copper based drilling thread compound having friction factors of 1.0 to 1.20 is ideal.
- DO NOT use any storage compound as a drilling thread compound as this compound does not have the properties to withstand makeup torques. It is always best practice to clean all compounds from connections and apply new running compound.
- Where the use of copper based thread compounds are restricted the use of "GREEN COMPOUNDS" that contain synthetic graphite and other non-metallic additives having friction factors of 1.0 to 1.2 can be substituted.

TORSIONAL AND MAKE-UP TORQUE CAPABILITIES

	Connection Type	Outside Diameter	Inside Diameter	Torsional Yield Strength	Tensile Yield Strength	Make-up Torque
		in.	in.	ft-lb	lbs	ft-lb
Single ShoulderConnections	NC38	5	2 7/16	22,200	708,100	11,700
	NC38	5	2 1/8	26,500	842,400	14,000
	NC46	6 1/4	3 1/4	34,000	901,200	17,600
	NC50	6 5/8	3 1/4	51,700	1,269,000	26,800
	NC50	6 5/8	2 3/4	63,400	1,551,700	32,900
	5-1/2 FH	7 1/2	3	87,200	1,925,500	44,600
	5-1/2 FH	7 1/2	3 1/2	73,200	1,619,200	37,450
	6-5/8 FH	8 1/2	4 1/4	109,200	2,102,300	56,100
Double Shoulder Connections	NC38 DS	4 1/2	2 7/16	17,500	708,100	10,517
	NC38 DS	5	2 7/16	29,000	708,100	17,400
	5-1/2 FHDS	7	4	72,900	1,292,500	43,800
	6-5/8 FHDS	8 1/2	4 1/4	159,700	2,133,900	95,800

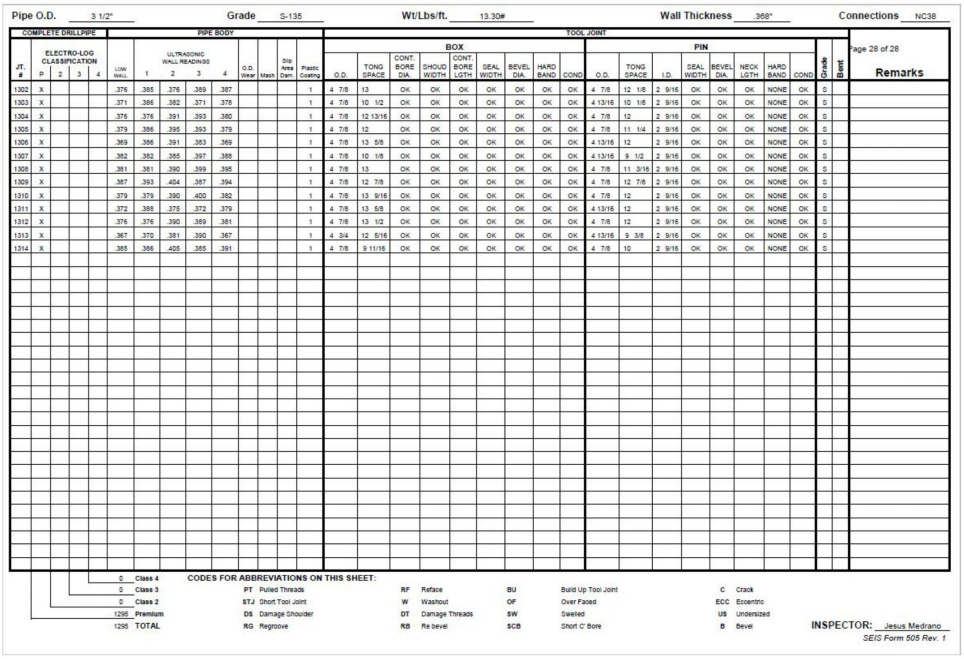
- Differences in torsional and tensile capabilities between Single Shoulder and Double Shoulders.

TORSIONAL AND MAKE-UP TORQUE CAPABILITIES (Metric)

	Connection Type	Outside Diameter	Inside Diameter	Torsional Yield Strength	Tensile Yield Strength	Make-up Torque
		mm	mm	N-m	kN	N-m
Single ShoulderConnections	NC38	127.00	61.91	30,099	3,149.78	15,863
	NC38	127.00	53.98	35,929	3,747.18	18,981
	NC46	158.75	82.55	46,098	4,008.74	23,862
	NC50	168.28	82.55	70,096	5,644.79	36,336
	NC50	168.28	69.85	85,959	6,902.30	44,606
	5-1/2 FH	190.50	76.20	118,227	8,565.05	60,469
	5-1/2 FH	190.50	88.90	99,246	7,202.56	50,775
	6-5/8 FH	215.90	107.95	148,055	9,351.49	76,061
Double Shoulder Connections	NC38 DS	114.30	61.91	23,727	3,149.78	14,259
	NC38 DS	127.00	61.91	39,319	3,149.78	23,591
	5-1/2 FHDS	177.80	101.60	98,839	5,749.32	59,385
	6-5/8 FHDS	215.90	107.95	216,524	9,492.06	129,887

- Differences in torsional and tensile capabilities between Single Shoulder and Double Shoulders.

DRILLING TUBULARS INSPECTION



Pipe O.D. 3 1/2" Grade S-135 Wt/Lbs/ft. 13.30# Wall Thickness .368" Connections NC38

COMPLETE DRILLPIPE | PIPE BODY | TOOL JOINT (BOX / PIN) | Page 28 of 28

JT. #	ELECTRO-LOG CLASSIFICATION P	2	3	4	LOW WALL	ULTRASONIC WALL READINGS 1	2	3	4	O.D. Wear	Mech	Slip Area Dam.	Plastic Coating	BOX O.D.	TONG SPACE	CONT. BORE DIA.	SHOUD WIDTH	CONT. BORE LGTH	SEAL WIDTH	BEVEL DIA.	HARD BAND	COND.	PIN O.D.	TONG SPACE	I.D.	SEAL WIDTH	BEVEL DIA.	NECK LGTH	HARD BAND	COND.	Grade	Bent	Remarks
1302	X				.376	.385	.376	.389	.387				1	4 7/8	13	OK	OK	OK	OK	OK	OK	OK	4 7/8	12 1/8	2 9/16	OK	OK	OK	NONE	OK	S		
1303	X				.371	.386	.382	.371	.378				1	4 7/8	10 1/2	OK	OK	OK	OK	OK	OK	OK	4 13/16	10 1/8	2 9/16	OK	OK	OK	NONE	OK	S		
1304	X				.376	.376	.391	.393	.380				1	4 7/8	12 13/16	OK	OK	OK	OK	OK	OK	OK	4 7/8	12	2 9/16	OK	OK	OK	NONE	OK	S		
1305	X				.379	.386	.395	.393	.379				1	4 7/8	12	OK	OK	OK	OK	OK	OK	OK	4 7/8	11 1/4	2 9/16	OK	OK	OK	NONE	OK	S		
1306	X				.369	.386	.391	.383	.369				1	4 7/8	13 5/8	OK	OK	OK	OK	OK	OK	OK	4 13/16	12	2 9/16	OK	OK	OK	NONE	OK	S		
1307	X				.382	.382	.385	.397	.388				1	4 7/8	10 1/8	OK	OK	OK	OK	OK	OK	OK	4 13/16	9 1/2	2 9/16	OK	OK	OK	NONE	OK	S		
1308	X				.381	.381	.390	.399	.395				1	4 7/8	13	OK	OK	OK	OK	OK	OK	OK	4 7/8	11 3/16	2 9/16	OK	OK	OK	NONE	OK	S		
1309	X				.387	.393	.404	.387	.394				1	4 7/8	12 7/8	OK	OK	OK	OK	OK	OK	OK	4 7/8	12 7/8	2 9/16	OK	OK	OK	NONE	OK	S		
1310	X				.379	.379	.390	.400	.382				1	4 7/8	13 9/16	OK	OK	OK	OK	OK	OK	OK	4 7/8	12	2 9/16	OK	OK	OK	NONE	OK	S		
1311	X				.372	.388	.375	.372	.379				1	4 7/8	13 5/8	OK	OK	OK	OK	OK	OK	OK	4 13/16	12	2 9/16	OK	OK	OK	NONE	OK	S		
1312	X				.376	.376	.390	.389	.381				1	4 7/8	13 1/2	OK	OK	OK	OK	OK	OK	OK	4 7/8	12	2 9/16	OK	OK	OK	NONE	OK	S		
1313	X				.367	.370	.381	.390	.367				1	4 3/4	12 5/16	OK	OK	OK	OK	OK	OK	OK	4 13/16	9 3/8	2 9/16	OK	OK	OK	NONE	OK	S		
1314	X				.385	.386	.405	.385	.391				1	4 7/8	9 11/16	OK	OK	OK	OK	OK	OK	OK	4 7/8	10	2 9/16	OK	OK	OK	NONE	OK	S		

0 Class 4
0 Class 3
0 Class 2
1296 Premium
1296 TOTAL

CODES FOR ABBREVIATIONS ON THIS SHEET:

PT Pulled Threads
STJ Short Tool Joint
DS Damage Shoulder
RG Regroove
RF Reface
W Washout
DT Damage Threads
RB Re bevel
BU Build Up Tool Joint
OF Over Faced
SW Swelled
SCB Short C' Bore
C Crack
ECC Eccentric
US Undersized
B Bevel

INSPECTOR: Jesus Medrano

SEIS Form 505 Rev. 1

- Drilling tubulars sample inspection report showing inspection parameters for used drilling tubulars.

DCA

22th DCA Annual Congress | Dordrecht 2017

DRILLING TUBULARS DOCUMENTATION PACKAGE

TSC Drill Pipe
A Division of Texas Steel Conversion, Inc.

CERTIFICATE of COMPLIANCE

TSC DRILL PIPE
PURCHASE ORDER NUMBER
531

SALES ORDER NUMBERS
057/0243A

SPECIFICATIONS (applicable parts):
API: 5DP 1st EDITION (08-01-10)

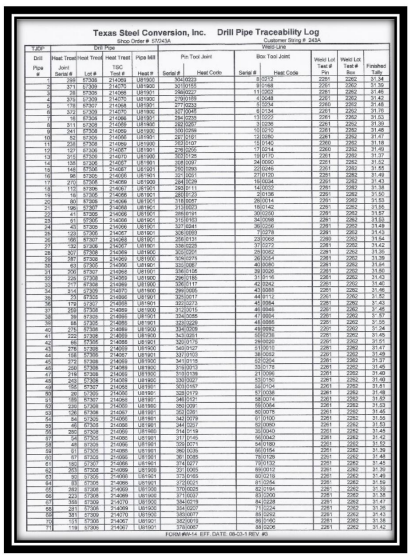
This hereby certifies that the herein described material meets the requirements of the above referenced documents.

TSC DRILL PIPE STRING#: 243A
SERIAL#s: 001-387

387 JTS., 12,174.83', 6.625, 0.362w, S135, 95% WALL, RANGE 2, IEU, 8-1/2" x 4-1/4" TOOL JOINTS (2" I.TS), 6-5/8 FH (ZINC PHOSPHATE ANTI-GALL TREATMENT), 65,012 FT-LBS(3X) MAKE & BREAK, CLOSED THREAD PROTECTORS MAX LENGTH 32.00' MIN LENGTH 31.01' VARIANCE 0.99'

V.P. QUALITY

12/15/16
DATE



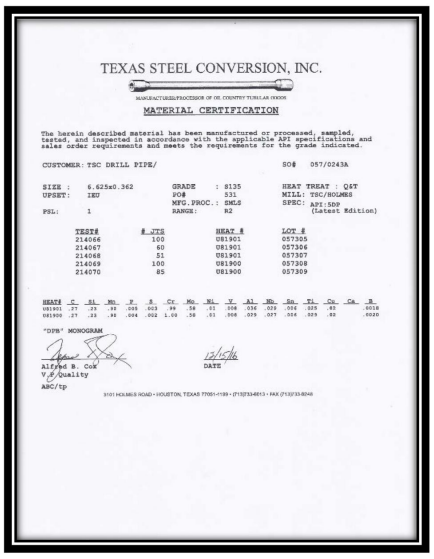
Texas Steel Conversion, Inc. Drill Pipe Traceability Log

- Drilling tubulars documentation package are provided with new drilling tubulars to show the quality checks and material metallurgical validation, traceability and certification.

DCA

22th DCA Annual Congress | Dordrecht 2017

DRILLING TUBULARS DOCUMENTATION PACKAGE



TEXAS STEEL CONVERSION, INC.

MANUFACTURER/PROCESSOR OF OIL COUNTRY TUBULAR GOODS

MATERIAL CERTIFICATION

The herein described material has been manufactured or processed, sampled, tested, and inspected in accordance with the applicable API specifications and sales order requirements and meets the requirements for the grade indicated.

CUSTOMER: TSC DRILL PIPE/ SO# 057/0243A

SIZE : 6.625x0.362 GRADE : S135 HEAT TREAT : Q&T
UPSET: IEU PO# 531 MILL: TSC/HOLMES
MFG.PROC.: SMLS SPEC: API:5DP
PSL: 1 RANGE: R2 (latest Edition)

TEST#	# JTS	HEAT #	LOT #
214066	100	U81901	057305
214067	60	U81901	057306
214068	51	U81901	057307
214069	100	U81900	057308
214070	85	U81900	057309

HEAT#	C	Si	Mn	P	S	Cr	Mo	Ni	V	Al	Nb	Sn	Ti	Cu	Ca	B
U81901	.27	.23	.92	.008	.002	.99	.58	.01	.006	.036	.029	.006	.005	.02		.0018
U81900	.27	.23	.92	.006	.002	1.00	.58	.01	.006	.035	.027	.006	.005	.02		.0020

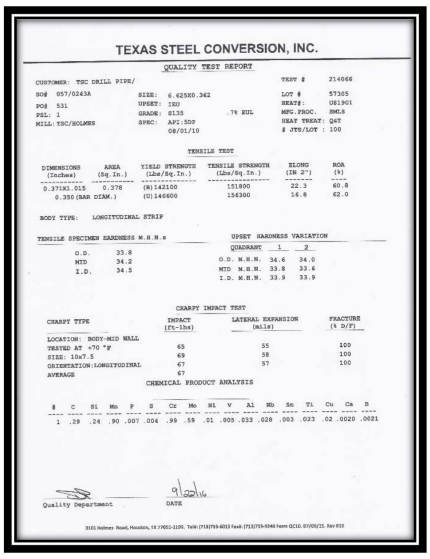
"DPB" MONOGRAM

Alfred B. Cox
V.P. Quality

12/15/16
DATE

ABC/tp

3101 HOLMES ROAD • HOUSTON, TEXAS 77051-1199 • (713)733-4613 • FAX (713)733-6248



TEXAS STEEL CONVERSION, INC.

QUALITY TEST REPORT

CUSTOMER: TSC DRILL PIPE/ TEST # 214066
SO# 057/0243A SIZE: 6.625X0.362 LOT # 57365
PO# 531 UPSET: IEU HEAT#: U81901
PSL: 1 GRADE: S135 .7% EUL MFG.PROC. SMLS
MILL: TSC/HOLMES SPEC: API:5DP HEAT TREAT: Q&T
08/01/10 # JTS/LOT : 100

TENSILE TEST

DIMENSIONS (Inches)	AREA (Sq.In.)	YIELD STRENGTH (Lbs/Sq.In.)	TENSILE STRENGTH (Lbs/Sq.In.)	ELONG (IN 2")	ROA (%)
0.371X1.015	0.378	(R)142100	151800	22.3	60.8
0.350(BAR DIM.)		(O)146600	154300	16.8	62.0

BODY TYPE: LONGITUDINAL STRIP

TENSILE SPECIMEN HARDNESS M.H.N.#

O.D.	33.8
MID	34.2
I.D.	34.5

UPSET HARDNESS VARIATION

QUADRANT	1	2
O.D. M.H.N.	34.6	34.0
MID M.H.N.	33.8	33.6
I.D. M.H.N.	33.9	33.9

CHARPY IMPACT TEST

CHARPY TYPE	IMPACT (ft-lbs)	LATERAL EXPANSION (mils)	FRACTURE (% D/F)
LOCATION: BODY-MID WALL			
TESTED AT +70 °F	65	55	100
SIZE: 10x7.5	69	58	100
ORIENTATION:LONGITUDINAL	67	57	100
AVERAGE	67		

CHEMICAL PRODUCT ANALYSIS

#	C	Si	Mn	P	S	Cr	Mo	Ni	V	Al	Nb	Sn	Ti	Cu	Ca	B
1	.29	.24	.90	.007	.004	.99	.59	.01	.005	.033	.028	.003	.023	.02	.0020	.0021

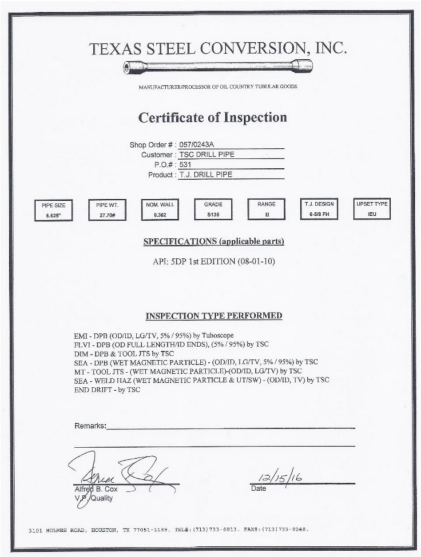
Quality Department

9/2/16
DATE

3101 Holmes Road, Houston, TX 77051-1199 Tel# (713)733-6013 Fax# (713)733-6248 Form QC10. 07/05/15. Rev #10

- Drilling tubulars documentation package should include pipe material metallurgical validation for properties and chemistry composition.

DRILLING TUBULARS DOCUMENTATION PACKAGE



TEXAS STEEL CONVERSION, INC.

MANUFACTURER/PROCESSOR OF OIL COUNTRY TUBULAR GOODS

Certificate of Inspection

Shop Order # : 057/0243A
Customer : TSC DRILL PIPE
P.O.# : 531
Product : T.J. DRILL PIPE

PIPE SIZE	PIPE WT.	NOM. WALL	GRADE	RANGE	T.J. DESIGN	UPSET TYPE
6.625"	27.70#	0.362	S135	II	6-5/8 FH	IEU

SPECIFICATIONS (applicable parts)

API: 5DP 1st EDITION (08-01-10)

INSPECTION TYPE PERFORMED

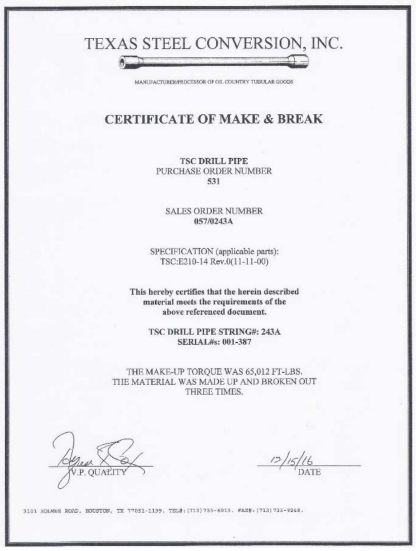
EMI - DPB (OD/ID, LG/TV, 5% / 95%) by Tuboscope
FLVI - DPB (OD FULL LENGTH/ID ENDS), (5% / 95%) by TSC
DIM - DPB & TOOL JTS by TSC
SEA - DPB (WET MAGNETIC PARTICLE) - (OD/ID, LG/TV, 5% / 95%) by TSC
MT - TOOL JTS - (WET MAGNETIC PARTICLE)-(OD/ID, LG/TV) by TSC
SEA - WELD HAZ (WET MAGNETIC PARTICLE & UT/SW) - (OD/ID, TV) by TSC
END DRIFT - by TSC

Remarks:

Alfred B. Cox
V.P. Quality

12/15/16
Date

3101 HOLMES ROAD, HOUSTON, TX 77051-1199. TEL#:(713)733-6013. FAX#:(713)733-9248.



TEXAS STEEL CONVERSION, INC.

MANUFACTURER/PROCESSOR OF OIL COUNTRY TUBULAR GOODS

CERTIFICATE OF MAKE & BREAK

TSC DRILL PIPE
PURCHASE ORDER NUMBER
531

SALES ORDER NUMBER
057/0243A

SPECIFICATION (applicable parts):
TSC:E210-14 Rev.0(11-11-00)

This hereby certifies that the herein described material meets the requirements of the above referenced document.

TSC DRILL PIPE STRING#: 243A
SERIAL#s: 001-387

THE MAKE-UP TORQUE WAS 65,012 FT-LBS.
THE MATERIAL WAS MADE UP AND BROKEN OUT THREE TIMES.

V.P. QUALITY

12/15/16
DATE

3101 HOLMES ROAD, HOUSTON, TX 77051-1199. TEL#:(713)733-6013. FAX#:(713)733-9248.

- Drilling tubulars documentation package also include Certification of NDT Inspection and of In-House make and break if one was performed per customer requirement.

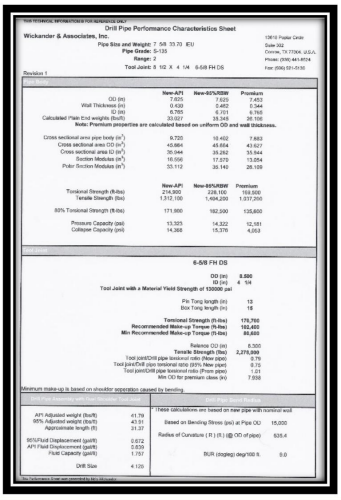
DRILLING TUBULARS MANUFACUTURES WORLDWIDE

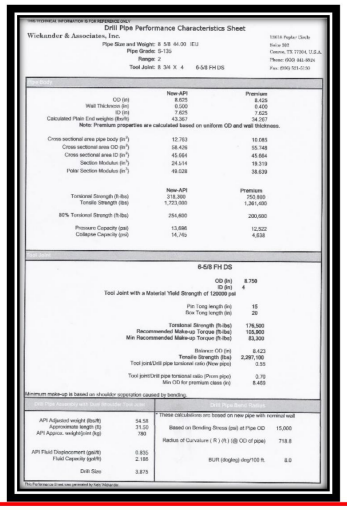
- Drilling tubulars are manufactured in different parts of the world, depending on the customers' preference and region these can be purchased to meet industry standards along with customer specifications.

- USA Manufactures:
  - NOV/GrantPrideco
  - Vallourec
  - TSC – Texas Steel Conversion
  - SDP – Superior Drillpipe
- Non-USA Manufactures - China
  - JSH – Jiangsu Shuguang Huayang Group
  - DPM – Drillpipe Masters
  - Hilong
  - Wiema
  - GPJ (NOV)
- Non-USA Manufactures - France
  - Vallourec

NEW LARGER SIZE DRILING TUBULARS INNOVATIONS

- Emergence of new larger, stronger, high capacity drilling tubulars have been design in the recent years to accommodate the more difficult drilling challenges and needs.
- Some of these sizes are:
  - 7-5/8" IEU 33.70# .430wt S135 with 6-5/8 FHDS (8-1/2" OD X 4-1/4" ID) R2
  - 8-5/8" IEU 44.00# .500wt S135 with 6-5/8 FHDS (8-3/4" OD X 4" ID) R2


Drill Pipe Performance Characteristics Sheet
Wickander & Associates, Inc.
6-5/8 FH DS


Drill Pipe Performance Characteristics Sheet
Wickander & Associates, Inc.
6-5/8 FH DS

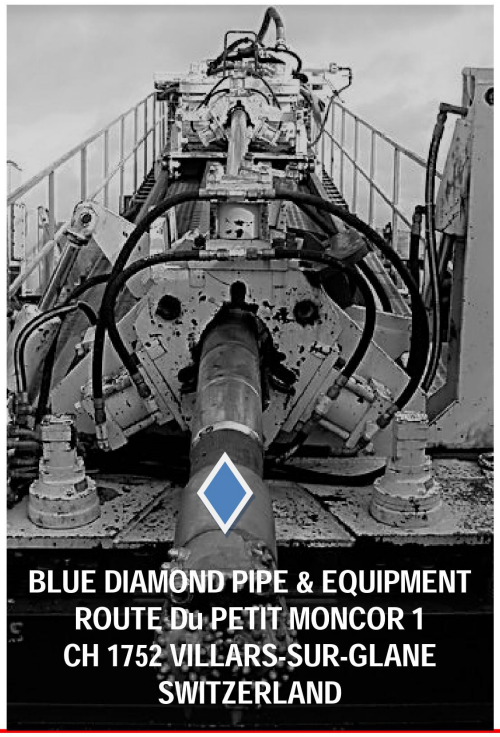
QUESTIONS OR COMMENTS???

CONTACT INFORMATION

TIGER TRADING, INC.
13168 POPLAR CIRCLE, #301
CONROE, TEXAS 77304
USA

Phone: 936.441.8877
Fax: 936.521.5130
Mobile: 713.201.7325
Contact: Thorn Huffman
Email: thorn@tigertrading.net

TUBULAR PRODUCTS



Board

President:	Marc Schnau (Bohlen & Doyen Bauunternehmung GmbH, Germany)	
Vice-President:	Jorn Stoelinga (Visser & Smit Hanab bv, Netherlands)	
Treasurer:	Jürgen Muhl (Step Oiltools GmbH, Germany)	
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Quality Assurance:	Dr. Tim Jaguttis (de la Motte & Partner Ingenieurgesellschaft mbH, Germany)	
Public Relations:	Marco Reinhard (LEONHARD WEISS GmbH & Co. KG, Germany)	
Education:	Ernst Fengler (LMR Drilling GmbH, Germany)	

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Email: dca@dca-europe.org, www.dca-europe.org

Regular Member

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2	**Beermann Bohrtechnik GmbH** Heinrich-Niemeyer-Str.50 48477 Hörstel-Riesenbeck, Germany	**Contact**:Steffen Beermann Phone:+49 (5454) 930523 Fax:+49 (5454) 930575023 E-Mail: Hermann.Luebbers@beermann.de www.beermann.de
3	**BLK - Bohrteam GmbH** OT Görschen Gewerbegebiet Südring 2 06618 Mertendorf, Germany	**Contact**:Peter Schume Phone:+49 (34445) 70130 Fax:+49 (34445) 70170 E-Mail: peter.schume@blk-bohrteam.de www.blk-bohrteam.de
4	**Bohlen & Doyen GmbH** Hauptstr. 248 26639 Wiesmoor, Germany	**Contact**:Marc Schnau Phone:+49 (4944) 3010 Fax:+49 (4944) 301130 E-Mail: info@bohlen-doyen.com www.bohlen-doyen.com
5	**Bohrservice Rhein-Main Gesellschaft für Horizontalbohrungen mbH** Wormser Str. 100 55294 Bodenheim, Germany	**Contact**:Michael Illner Phone:+49 (6135) 932280 Fax:+49 (6135) 9322893 E-Mail: info@bohrservice-rhein-main.de www.bohrservice-rhein-main.de
6	**Bohrtechnik Brück** Straße des Friedens 93 14822 Brück, Germany	**Contact**:Thomas Baitz Phone:+49 (33844) 54620 Fax:+49 (33844) 54699 E-Mail: post@bohrtechnik-brueck.de www.bohrtechnik-brueck.de
7	**BTW Bohrtec-Teubner Wittenberg GmbH** Schatzungsstr. 22 06886 Wittenberg, Germany	**Contact**:Joachim Teubner Phone:+49 (3491) 404297 Fax:+49 (3491) 409600 E-Mail: btw-horizontalbohrtechnik@gmx.de www.bohrtec-teubner.de
8	**Catalana de Perforacions S.A.** Pol. Ind. "Santa Anna 1" km 4.2 08251 Santpedor (Barcelona), Spain	**Contact**:Jordi Camps Querol Phone:+34 (93) 902932949 Fax:+34 (938) 273852 E-Mail: perforacions@catalanadeperforacions.com www.catalanadeperforacions.com
9	**China Petroleum Pipeline Bureau (CPP)** No.87 Guangyang Road 065000 Langfang City, Hebei Province, China	**Contact**:Shaochun Zhao Phone:+86 (316) 2171607 Fax:+86 (316) 2171620 E-Mail: 84880158@qq.com www.cnpc.com.cn
10	**Coquart et Fils** 10ter, rue Wathieumetz 62130 Saint Michel Sur Ternoise, France	**Contact**:Francois Coquart Phone:+33 (3) 21032079 Fax:+33 (3) 21046770 E-Mail: contact@coquart.eu www.coquart.eu
11	**Gebr. van Leeuwen Boringen B.V.** Ampereweg 17 3442 AB Woerden, Netherlands	**Contact**:Kor Mossel Phone:+31 (348) 477100 Fax:+31 (348) 443754 E-Mail: info@gvlboringen.com www.gebr-vanleeuwen.nl
12	**Gendry Service Location GSL** 1 rue de Hongrie 53400 Craon, France	**Contact**:Jeremie Gendry Phone:+33 (2430) 60479 Fax:+33 (2430) 75203 E-Mail: j.gendry@gendrylocation.com
13	**H&E Bohrtechnik GmbH** Im Gewerbepark 6 07646 Bollberg, Germany	**Contact**:Thomas Heidler Phone:+49 (36428) 51330 Fax:+49 (36428) 513310 E-Mail: info@hue-bohrtechnik.de www.hue-bohrtechnik.de
14	**H.Spiekermann Bohrtechnik GmbH** Zum Sorpetal 20-24 57392 Schmallenberg, Germany	**Contact**:Christof Spiekermann Phone:+49 (2975) 809240 Fax:+49 (2975) 809224 E-Mail: info@spiekermann-bohrtechnik.de www.spiekermann-bohrtechnik.de

Regular Member

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16	**Karl Huneke Straßen- u. Tiefbau GmbH** Großer Stein 5 26789 Leer, Germany	**Contact**:Florian Backer Phone:+49 (491) 92960 Fax:+49 (491) 929688 E-Mail: huneke@huneke.de www.huneke.de
17	**Kollmer Bohr und Tiefbau GmbH** Marktplatz 8 91281 Kirchenthumbach, Germany	**Contact**:Stephan Kohl Phone:+49-9647 9203-0 Fax:+49-9647 9203-26 E-Mail: info@kollmer-bau.de www.kollmer-bau.de
18	**Kroiss Bohrtechnik GmbH** Unterradlsbach 6 94439 Rossbach, Germany	**Contact**:Roland Kroiss Phone:+49 (8564) 96110 Fax:+49 (8564) 961111 E-Mail: info@kroiss-web.de www.kroiss-web.de
19	**LEONHARD WEISS GmbH & Co. KG** Paul-Ehrlich-Straße 2 71229 Leonberg-Höfingen, Germany	**Contact**:Marco Reinhard Phone:+49 (7152) 901400 Fax:+49 (7152) 9014022 E-Mail: m.reinhard@leonhard-weiss.com www.leonhard-weiss.de
20	**LMR Drilling GmbH** Ammerländer Heerstr. 368 26129 Oldenburg, Germany	**Contact**:Ernst Fengler Phone:+49 (441) 9719110 Fax:+49 (441) 9719191 E-Mail: kruse@lmr-drilling.de www.lmr-drilling.de
21	**LÜBA Leitungsbau GmbH** Raiffeisenstraße 2 31275 Lehrte-Ahlten, Germany	**Contact**:Andreas Ahmann Phone:+49 (51) 32869961 Fax:+49 (51) 32869969 E-Mail: info@imd-gmbh.net www.lueba.de
22	**Max Wild GmbH** Leutkircher Str. 22 88450 Berkheim, Germany	**Contact**:Christian Wild Phone:+49 (8395) 9200 Fax:+49 (8395) 920150 E-Mail: cwild@maxwild.com www.maxwild.com
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24	**MTS GmbH** Quitzerower Weg 13C 17109 Demmin, Germany	**Contact**:Bodo Jordan Phone:+49 (3998) 27410 Fax:+49 (3998) 222188 E-Mail: mts@mts-demmin.de
25	**NWR Bohrtechnik GmbH** Deutschlandschachtstr. 16 09376 Oelsnitz/Erzgebirge, Germany	**Contact**:Thomas Winter Phone:+49 (37298) 301250 Fax:+49 (37298) 3012525 E-Mail: info@nwr-bohrtechnik.de www.nwr-bohrtechnik.de
26	**Otto Schröder Tiefbaugesellschaft mbH** Am Vogelsang 9-11 29640 Schneverdingen, Germany	**Contact**:Detlef Busch Phone:+49 (5193) 8090 Fax:+49 (5193) 809149 E-Mail: info@schroeder-tiefbau.de www.schroeder-tiefbau.de
27	**Otto Schubert GmbH** Albert-Stolte-Str. 31 46399 Bocholt-Suderwick, Germany	**Contact**:Werner Scheipers Phone:+49 (2553) 93570 Fax:+49 (2553) 935726 E-Mail: w.scheipers@schubert-rohr.de www.schubert-rohr.de
28	**RTH Rohr- und Tiefbau Hoya GmbH** Hertzstr. 2-4 27318 Hoya, Germany	**Contact**:Sven Behrmann Phone:+49 (4251) 93300 Fax:+49 (4251) 933039 E-Mail: info@rth.de www.rth.de

Regular Member

29	**S & V Tiefbautechnik GmbH** Am Vogelsang 9-11 29640 Schneverdingen, Germany	**Contact**:Holger Vorwerk Phone:+49 (5193) 80980 Fax:+49 (5193) 80989 E-Mail: suv.vorwerk@t-online.de www.s-v-tiefbau.de
30	**Schulte-Perk GmbH** Hauptstrasse 652 26683 Saterland-Strücklingen, Germany	**Contact**:Magnus Perk Phone:+49 (4498) 430 Fax:+49 (4498) 2794 E-Mail: info@schulte-perk.de www.mea-gmbh.com
31	**Thomsen Bohrtechnik GmbH & Co. KG** Am Mühlenberg 5 18059 Ziesendorf, Germany	**Contact**:Tobias Kock Phone:038207 759 236 Fax:038207 759 387 E-Mail: info@thomsen-bohrtechnik.de www.thomsen-bohrtechnik.de
32	**Tief- und Rohrleitungsbau Wilhelm Wähler GmbH** Kaistrasse 5-6 27657 Bremerhaven, Germany	**Contact**:Michael Fredrich Phone:+49 (471) 92922535 Fax:+49 (471) 92922522 E-Mail: info@waehler.de www.waehler.de
33	**Visser & Smit Hanab bv** Postfach 305 3350 AH Papendrecht, Netherlands	**Contact**:Jorn Stoelinga Phone:+31 (78) 6417222 Fax:+31 (78) 6155163 E-Mail: j.stoelinga@vshanab.nl www.vshanab.nl
34	**Wadle Bauunternehmung GmbH** Oskar-von-Miller-Straße 8 84051 Altheim/Landshut, Germany	**Contact**:Rainer Rothenaicher Phone:+49 (8703) 93985210 Fax:+49 (8703) 93985230 E-Mail: wadle.altheim@wadle.de www.wadle.de
35	**Watterodt Bohrtechnik GmbH** Alte Straße 356a 99765 Görsbach, Germany	**Contact**:Reimond Watterodt Phone:+49 (36333) 60687 Fax:+49 (36333) 60689 E-Mail: watterodtbau@t-online.de www.watterodtbau.de
36	**WBW GmbH** Kleiner Bollen 1 26826 Weener, Germany	**Contact**:Nils Zimmermann Phone:+49 (4951) 950300 Fax:+49 (4951) 950310 E-Mail: n.zimmermann@wbw-weener.de www.wbw-weener.de
37	**WMZ Bohrtechnik GmbH & Co.KG** Papiermühlenweg 14 89426 Wittislingen, Germany	**Contact**:Erwin Zintz Phone:+49 (9076) 958608 Fax:+49 (9076) 958638 E-Mail: wmz1-bohrtechnik@t-online.de www.wmz-bohrtechnik.de
38	**ZRB Janicki** Ligonia 4 44-186 Gieraltowice, Poland	**Contact**:Jacek Janicki Phone:+48 (32) 2353094 Fax:+48 (32) 2353094 E-Mail: biuro@janicki.com.pl www.janicki.com.pl

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8	**Brownline b.v.** Duurzaamheidspring 180 4237 EX Meerkerk, Netherlands	**Contact**:Hans de Bruin Phone:+31 (183) 353824 Fax:+31 (183) 353829 E-Mail: hans@drillguide.com
9	**Cebo Holland B.V.** Westerduinweg 1 1976 BV Ijmuiden, Netherlands	**Contact**:Fred Blomsma Phone:+31 (255) 546262 Fax:+31 (255) 546202 E-Mail: fred.blomsma@cebo.com www.ceboholland.nl
10	**Cetco DPG** st. Graniczna 4b/66 35-326 Rzeszow, Poland	**Contact**:Krzysztof Gaszcz Phone:+48 (89) 62478300 Fax:+48 (89) 62478307 E-Mail: biuro@cetco.pl www.cetco.pl
11	**Clariant Produkte (Deutschland) GmbH** Ostenrieder Str. 15 85368 Moosburg, Germany	**Contact**:Joseph Heilmeier Phone:+49 (8761) 82378 Fax:+49 (8761) 82665 E-Mail: joseph.heilmeier@clariant.com www.clariant.com
12	**Clear Solutions International Ltd** Unit B3 Wem Industrial Estate, Soulton Road, Wem SY4 5SD Shropshire, U.K.	**Contact**:Oliver Kuchar Phone:+44 (1939) 235754 Fax:+44 (1939) 232399 E-Mail: info@drilling-products.com www.drilling-products.com
13	**de la Motte & Partner Ingenieurgesellschaft mbH** Birkenweg 11 21465 Reinbek, Germany	**Contact**:Tim Jaguttis Phone:+49 (40) 21116590 Fax:+49 (40) 211165929 E-Mail: mail@delamotte-partner.de www.delamotte-partner.de
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18	**Dr. Donié Geo-Consult GmbH** Am Hang 3 76307 Karlsbad, Germany	**Contact**:Christoph Donié Phone:+49 (7202) 941680 Fax:+49 (7202) 941681 E-Mail: cd@donie-geo-consult.de www.donie-geo-consult.de
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22	**egeplast International GmbH** Robert-Bosch-Str. 7 48268 Greven, Germany	**Contact**:Holger Hesse Phone:+49 (2575) 97100 Fax:+49 (2575) 9710269 E-Mail: Holger.Hesse@egeplast.de www.egeplast.de
23	**Epiroc Deutschland GmbH** Langemarckstraße 35 45141 Essen, Germany	**Contact**:Dieter Koß Phone:+49 (201) 21770 Fax:+49 (201) 2177454 E-Mail: dieter.koss@de.atlascopco.com www.atlascopco.de
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25	**FLUXYS Belgium S. A.** Avgenue des Arts 31 B-1040 Bruxelles, Belgium	**Contact**:Marc Simoen Phone:+32 (228) 27460 Fax:+32 (223) 00289 E-Mail: Marc.Simoen@fluxys.com www.fluxys.com
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49	**Prime Horizontal** Salland 3 1948 RE Beverwijk, Netherlands	**Contact**:Dan Billig Phone:+31 (251) 271790 Fax:+31 (251) 271064 E-Mail: office@primehorizontal.com www.primehorizontal.com
50	**Prime-GPT (German Pump Technology) GmbH** Ludwig Erhard Straße 4 57482 Wenden, Germany	**Contact**:Ralf Kiesow Phone:+49 (2762) 986900 Fax:+49 (2762) 98690290 E-Mail: info@prime-gpt.de www.prime-gpt.de
51	**Reduct Pipeline Mapping Systems** Molenberglei 42 B-2627 Schelle, Belgium	**Contact**:Otto Ballintijn Phone:+32 (3) 4517739 Fax:+32 (3) 4517731 E-Mail: otto.ballintijn@reduct.net www.ductrunner.com
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62	**Tracto-Technik GmbH & Co. KG** Paul-Schmidt-Str. 2 57368 Lennestadt, Germany	**Contact**:Burkhard Rarbach Phone:+49 (2723) 80132 Fax:+49 (2723) 80212 E-Mail: burkhard.rarbach@tracto-technik.de www.tracto-technik.de
63	**Transco Downhole Drilling Tools GmbH** Wernerusstrr. 22 29227 Celle, Germany	**Contact**:Dirk Müller Phone:+49 (160) 97949918 Fax: E-Mail: dm@transcomfg.com www.transco.com
64	**Transco MFG Australia PTY LTD** 3 Hull Court P.O.Box 13 5160 Lonsdale, Australia	**Contact**:George Fyfe Phone:+61 (8) 83265599 Fax:+61 (8) 83261264 E-Mail: transco@a011.aone.net.au www.transco.com.au
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68	**Westnetz GmbH** Friedrichstraße 60 Regionalzentrum Sieg 57072 Siegen, Germany	**Contact**:Stephan Birtner Phone:+49 (231) 4382403 Fax:+49 (231) 4383010 E-Mail: stephan.birtner@westnetz.de www.rwe.com

Extraordinary and Honoary Members

Extraordinary Members

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Honorary Members

Johannes A. Ringers, M. Sc (C.E.) Delft

Gründungsmitglied des DCA
Präsident: 1997 bis 2003
Vizepräsident: 1995 bis 1997

DCA Members application

Application form

If you want to become a member of the Drilling Contractors Association (DCA), please complete the application form and return it to our office. The board decides on the admission of candidates and their classification into member groups on a case-by-case basis (see scale of fees).

Please enclose the following documents with the application form for DCA membership:

☐ **HDD Company (regular):**

- Number of HDD drilling rigs: ____ Sum of all pulling forces: _____ KN
- Two reference letters from clients
- Information on the system of quality management
- A list of the projects of the last 3 years
- A brochure of your company and if possible your last published annual report.

☐ **Supplier, clients, engineering companies etc. (associated):**

- Number of persons employed by the company _____
- Information on the system of quality management
- A list of the projects of the last 3 years
- A brochure of your company and if possible your last published annual report

Company: _____

Area of business: _____

Representative: _____

Address: _____

_____

Phone/Fax: _____

Mail/Web: _____

Date: _____ Signature:_____

Drilling Contractors Association (DCA-Europe)
Dipl.-Geol. D. Quante
52068 Aachen - Germany - Charlottenburger Allee 39
Phone: 0241-9019 290; Fax -299: eMail: d.quante@dca-europe.org
Web: www.dca-euope.org

DCA - Scale of fees

Full Members

Every natural or legal person who is willing to promote the objectives of the association can become a member. The board decides on the membership after receipt of a request in written form. The association has regular members (drilling companies) and associate members (supplier companies). Regular members are legal or natural persons who professionally execute horizontal directional drillings with their own equipment. Associate members are legal or natural persons who are willing to promote the aims of the association but do not execute horizontal directional drillings themselves. An associate member who starts to execute horizontal directional drillings during his membership becomes a regular member. There are no differences between regular and associate members in terms of obligations and rights.

Setting membership fees

Drilling Companies (regular):

The membership fee for drilling companies is set on the basis of the sum of the pulling forces of the HDD drilling equipment owned by the company. The applicant has to indicate the sum of the pulling forces in the application form. After an application is filed, the board decides on the final classification into a contribution group. Any changes have to be reported to the DCA executive board immediately, however, no later than the next members' meeting in the following financial year. The fee is then adapted accordingly.

Group 1: Sum of all pulling forces	≤ 1,000 KN	1,050.00 €
Group 2: Sum of all pulling forces	> 1,000 ≤ 2,500 KN	2,100.00 €
Group 3: Sum of all pulling forces	> 2,500 KN	3,150.00 €

Supplier companies, consulting companies, clients, etc. (associate):

The membership fee for associate members is calculated on the basis of the number of persons employed by the company, whereas the size of the parent company is in each case taken account of. Under certain conditions and in individual cases this proceeding may be deviated from. The applicant has to indicate the number of persons employed in the application form. After the application is filled the board decides on the final classification into a contribution group. Any changes have to be reported to the DCA executive board immediately, however, no later than the next members's meeting in the following financial year. The fee is then adapted accordingly.

Group 1: Number of employees	< 5	840.00 €
Group 2: Number of employees	5 ≤ 50	1,050.00 €
Group 3: Number of employees	50 ≤ 200	1,320.00 €
Group 4: Number of employees	> 200	1,580.00 €

For further information please contact us at our office in Aachen (+49 (0) 241 – 90 19 290) or visit our homepage **www.dca-europe.org**.

DCA - Scale of fees

DCA-Mitgliedsantrag

Falls Sie Mitglied im Verband Güteschutz Horizontalbohrungen e.V. (DCA) werden möchten, senden Sie bitte dieses Antragsformular ausgefüllt an die unten angegebene Adresse zurück. Der Vorstand entscheidet hierbei im Einzelfall über die Aufnahme und die Einstufung in die jeweilige Mitgliedergruppe (siehe Angaben in der Beitragsordnung).

Folgende Unterlagen müssen den Anträgen auf aktive bzw. passive Mitgliedschaft beigelegt werden:

☐ **HDD-Bohrfirma (aktiv):**

- Anzahl der HDD-Bohrgeräte : ____ Summe aller Zugkräfte: _____ in KN

- Vorlage von mindestens zwei aktuellen Referenzschreiben von Auftraggebern
- Angaben zum Qualitätsmanagementsystem
- Eine Liste der Projekte der letzten 3 Jahre
- Ein Prospekt Ihrer Firma und, falls möglich, Ihr zuletzt veröffentlichter Jahresbericht.

☐ **Zulieferindustrie, Auftraggeber, Planer, Sachverständige etc. (passiv):**

- Anzahl der Beschäftigten im Unternehmen _____ Mitarbeiter

- Angaben zum Qualitätsmanagementsystem
- Eine Liste der Projekte der letzten 3 Jahre
- Ein Prospekt Ihrer Firma und, falls möglich, Ihr zuletzt veröffentlichter Jahresbericht.

Firma: _____

Branche: _____

Vertreter: _____

Anschrift: _____

_____

Telefon/Fax: _____

Mail/Web: _____

Datum: _____ Unterschrift: _____

Verband Güteschutz Horizontalbohrungen e.V. (DCA)
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DCA-Beitragsordnung

Ordentliche Mitglieder

Mitglied des Vereins kann jede natürliche oder jede juristische Person werden, die gewillt ist, den Vereinszweck zu fördern. Über die Aufnahme entscheidet der Vorstand nach schriftlichem Antrag. Der Verein hat aktive Mitglieder (Bohrfirmen) und passive Mitglieder (Zulieferindustrie, Auftraggeber, Planer, Sachverständige etc.). Aktive Mitglieder sind juristische Personen oder natürliche Personen, die gewerblich Horizontalbohrungen mit ihren eigenen Bohrgeräten herstellen. Passive Mitglieder sind juristische oder natürliche Personen, die gewillt sind, den Vereinszweck zu fördern, jedoch selbst keine Horizontalbohrungen erstellen. Ein passives Mitglied, das nach seinem Vereinsbeitritt gewerblich Horizontalbohrungen durchführt, wird dadurch zum aktiven Mitglied. Unterschiede innerhalb der Pflichten bzw. Rechte zwischen aktiven und passiven Mitgliedern gibt es nicht.

Festlegung der Mitgliedsbeiträge

HDD-Bohrfirmen (aktiv):

Die Festlegung der Mitgliedsbeiträge für Bohrfirmen erfolgt anhand der Summe der Zugkräfte der im Unternehmen vorhandenen HDD-Bohrgeräte. Der Antragsteller hat die Summe der Zugkräfte bei Antragstellung anzugeben. Über die endgültige Einstufung in die Beitragsgruppe entscheidet der Vorstand nach Antragstellung. Etwaige Änderungen sind dem DCA-Vorstand umgehend anzuzeigen, jedoch spätestens bis zur nächsten Mitgliederversammlung des darauffolgenden Geschäftsjahres. Der Beitrag wird dann entsprechend angepasst.

Gruppe 1: Summe aller Zugkräfte	≤ 1.000 KN	1.050,00 €
Gruppe 2: Summe aller Zugkräfte	> 1000 ≤ 2.500 KN	2.100,00 €
Gruppe 3: Summe aller Zugkräfte	> 2.500 KN	3.125,00 €

Zulieferindustrie, Auftraggeber, Planungsbüros, Sachverständige etc. (passiv).

Die Festlegung der Mitgliedsbeiträge der Zulieferindustrie (s.o.) erfolgt anhand der Anzahl der Beschäftigten in einem Unternehmen, wobei jeweils die Größe der Muttergesellschaft zu Grunde gelegt wird. Unter bestimmten Bedingungen kann im Einzelfall von dieser Vorgehensweise abgewichen werden. Der Antragsteller hat die Anzahl der Beschäftigten bei Antragstellung anzugeben. Über die endgültige Einstufung in die Beitragsgruppe entscheidet der Vorstand nach Antragstellung. Etwaige Änderungen sind dem DCA-Vorstand umgehend anzuzeigen, jedoch spätestens bis zur nächsten Mitgliederversammlung des darauffolgenden Geschäftsjahres. Der Beitrag wird dann entsprechend angepasst.

Gruppe 1: Anzahl Beschäftigte	< 5	840,00 €
Gruppe 2: Anzahl Beschäftigte	5 ≤ 50	1.050,00 €
Gruppe 3: Anzahl Beschäftigte	> 50 ≤ 200	1.320,00 €
Gruppe 4: Anzahl Beschäftigte	> 200	1.580,00 €

Bei Rückfragen wenden Sie sich bitte an unsere Geschäftsstelle unter (0241-9019290) oder schauen Sie doch einmal auf unserer Homepage unter www.dca-europe.de vorbei.