20th DCA Annual Congress | Marseille

DCA Annual Congress 2015

HDD - savoir-vivre - in network and pipeline construction

07th - 09th October 2015
Marseille, France

sponsored by:

TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE

FLUXYS

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

Editoral

Dear Ladies and Gentlemen, dear Members,

The most important and most beautiful event of the association casts its shadow before! The DCA will hold its regular annual congress again from October 07 – 09, 2015. Last year we berthed at the association's birth place, the regional capital Düsseldorf on river Rhine; this year we will accentuate our European orientation once more and therefore have chosen beautiful metropolis Marseille as meeting place.
Latitude 43°18`North and longitude 5°23`East guarantee fair weather also in October. 6.6 hours of sunshine per day and a pleasant temperature of around 21° C are promising.

Marseille is a major European and France's most important seaport. Here we will berth for some days in order to attend to the latest and most interesting developments within the HDD industry. A well-balanced congress programme awaits us. We could win over experienced lecturers as usual that will confront us with some highlights of the HDD technology. Pore over the programme; it will convince you that your "seminar list" should not lack Marseille.

Apart from this diversified congress programme, you will of course be provided with some touristic features as well. In this town between hills and sea there is really a lot to discover and experience. Being a widely recognised Capital of Culture since 2013, Marseille takes pride in its exceptionally wide variety of cultural offerings.

From an economic perspective, the town is strongly marked by its harbours. 14 (!) harbours altogether can be found in a coastal area of nearly 57 km. Not only the "Old Port" will be a highlight; also Europe's second biggest yacht club will surely be impressive.

Three French companies took no refusal to support our event financially. Without such generous sponsors our association could not organise an event like this in a cost-covering way. My thanks go to all our sponsors!

When we will hoist anchor on Friday noon finally, and like all sailors who have to leave a beautiful harbour, we will surely have a melancholic feeling. But let us for now look forward to a good congress and an interesting location. The groundwork was laid, merely your confirmation is lacking. Then we will have a great congress like in the past years!

I wish everybody a pleasant summer until then, relaxing vacations, and of course many good and productive projects.

Hoping to welcome all of you in Marseille, I remain with my best wishes,

Yours,

Hermann Lübbers, President

Vorwort

Sehr geehrte Damen und Herren, liebe Mitglieder,

das wichtigste und schönste Event des Verbands wirft seine Schatten voraus! Vom 07. bis zum 09. Oktober veranstaltet der DCA turnusgemäß wieder seinen Jahreskongress. Nachdem wir im letzten Jahr in der Geburtsstadt des Verbandes, der Landeshauptstadt Düsseldorf am Rhein vor Anker gegangen sind werden wir in diesem Jahr wieder unseren europäischen Ansprüchen gerecht und haben die schöne Metropole Marseille zum Tagungsort bestimmt.

Auf dem Breitenkreis 43°18`N sowie dem Längengrad 5°23`O ist auch im Oktober gutes Wetter nahezu garantiert. 6,6 Sonnenstunden pro Tag bei einer angenehmen Temperatur von ca. 21°C versprechen einiges.

Marseille ist eine bedeutende europäische und die wichtigste Hafenstadt Frankreichs. Hier werden wir ein paar Tage vor Anker gehen um uns den neuesten und interessantesten Entwicklungen der HDD-Industrie zu widmen. Es erwartet uns ein ausgewogenes, gutes Tagungsprogramm. Es wurden einmal mehr gute, erfahrene Referenten gewonnen, die uns mit manchen Highlights der HDD-Technologie konfrontieren werden. Studieren Sie das anliegende Programm, es wird Sie überzeugen, dass auch Marseille auf Ihrer „Seminarliste“ nicht fehlen darf.

Neben einem abwechslungsreichen Tagungsprogramm wird selbstverständlich auch ein klein wenig touristisches geboten. In der Stadt zwischen Hügeln und Meer gibt es ausgesprochen viel zu entdecken und zu erleben. Als anerkannte europäische Kulturhauptstadt wirbt diese Stadt seit 2013 für sein ausgesprochen breit gefächertes Kulturleben.

Wirtschaftlich gesehen ist die Stadt natürlich stark von seinem Hafen bzw. seinen Häfen geprägt. 14(!) Häfen erstrecken sich über ein Küstengebiet von nahezu 57 km. Neben dem „Alten Hafen“ stellt der zweitgrößte Segel- und Freizeithafen Europas sicherlich ein besonderes Highlight dar.

Drei französische Unternehmen haben es sich nicht nehmen lassen, unsere Veranstaltung finanziell zu unterstützen. Ohne derartige, großzügige Sponsoren ist eine derartige Veranstaltung nicht kostendeckend durchzuführen. Mein Dank gilt den Sponsoren!

Wenn wir am Freitagmittag dann die Anker lichten, werden wir alle wie jeder Segler der einen schönen Hafen verlassen muss, sicherlich ein wenig Wehmut verspüren. Aber erst mal sollten wir uns auf eine gute Tagung und auf einen interessanten Ort freuen. Die Basis ist gelegt, es fehlt nur noch Ihre Teilnahmebestätigung, dann wird es wie in den vergangenen Jahren ein guter Kongress! Ich wünsche allen bis dahin einen schönen Sommer, erholsame Urlaubstage sowie natürlich auch gute und Ertrag bringende Projekte.

In der Hoffnung Sie in Marseille begrüßen zu dürfen verbleibe ich mit den besten Wünschen

Ihr Präsident

Hermann Lübbers

Topic: HDD - Savoir-vivre - in network and pipeline construction

Program:

Wednesday, 07th of October 2015

11.30 – 18.00	**„Check in“** Hotel Villa Massalia, Marseille
13.00	**Lunch at Hotel Villa Massalia**
15.00	**„Discover Marseille – Le Panier and Notre Dame de la Garde“**
19.30	**„Cocktail reception”** sponsored by Hotel Villa Massalia
20.00	**Dinner at Hotel Villa Massalia**

Thursday, 08th of October 2015

09.00	**Welcome** Dipl.-Geol. Dietmar Quante, Executive Secretary DCA-Europe
09.15	**Welcome** Dipl.-Ing. (EWE) Hermann Lübbers, President DCA-Europe
09.30	**TIGF – In the future we trust** Josselin Nivet, TIGF
10.10	**Presentation of Ten-Year Network Development Plan (TYNDP) 2015** Carmen Rodríguez, ENTSOG -- European Network of Transmission System Operators for Gas
10.50	**Coffee break**
11.10	**Technical Contract Conditions in HDD - DIN ATV 18324 -** Dipl.-Ing. (EWE) Hermann Lübbers, Beermann Bohrtechnik GmbH
11.30	**DCA Technical Guidelines 2015** **- Introduction of the improvements, explanation -** Dipl.-Ing. (FH) Marc Schnau, Bohlen & Doyen GmbH
11.50	**Marseille historical visit** Corinne Sémarciyan

12.30 **Discussion**

13.00 **Lunch at Hotel Villa Massalia**

14.00 - 18.00 **Visit Marseille „Europort“**

19.00 **Meeting Hotel Lobby**

19.10 **Departure to the privatized beachside of “Espace Borely”**

19.30 **Welcome on the beach side of “Espace Borely"**

20.00 **Dinner and evening on the beach in the “Marseille style”**

Friday, 09th of October 2015

09.00 **Recovery of drilling fluids in application to the European norms**
Pierre Godillon, Clamens SA

09.30 **Full face Hole opening - A new drilling tool increases the performance of HDD in hard rock**
Dipl.-Ing. (FH) Michael Lubberger, Herrenknecht AG

10.00 **The NF P 94-500 norm applied to the geotechnical surveys for HDD projects**
Dominique Feldmann, geologist and sworn expert, Forexi

10.30 **Coffee break**

10.45 **Brazilian Sea Turtles watching gneiss HDD**
Alexis Filliette, Project Manager, HDI

11.15 **Aging pipelines in Europe – when to replace old pipelines**
Jan Spiekhout, Ir, Executive Senior Advisor, DNV GL - Oil & Gas

11.45 **Allt a Chonais - A Hard Rock Hydro Scheme**
Jez Seamans, Managing Director LMR Drilling UK Ltd

12.25 **Discussion**

12.45 **End of program**

13.00 **Lunch at Hotel Villa Massalia**

Tagungsthema: „HDD - Savoir-vivre - in network and pipeline construction“

Programm

Mittwoch, 07. Oktober 2015

11.30 – 18.00 Uhr	**„Check in“** Hotel Villa Massalia, Marseille
13.00 Uhr	**Mittagessen** im Hotel Villa Massalia
15.00 Uhr	**„Discover Marseille – Le Panier und Notre Dame de la Garde“**
19.30 Uhr	**„Cocktail reception”** gesponsert vom Hotel Villa Massalia
20.00 Uhr	**Abendessen** im Hotel Villa Massalia

Donnerstag, 08. Oktober 2015

09.00 Uhr	**Begrüßung** Dipl.-Geol. Dietmar Quante – Geschäftsführer DCA-Europe
09.15 Uhr	**Begrüßung** Dipl.-Ing. (EWE) Hermann Lübbers - Präsident DCA-Europe
09.30 Uhr	**TIGF – Vertrauen in die Zukunft** Josselin Nivet, TIGF
10.10 Uhr	**10-Jahresnetzentwicklungsplan (TYNDP) für Europa 2015** Carmen Rodríguez, ENTSOG -- European Network of Transmission System Operators for Gas
10.50 Uhr	**Kaffeepause**
11.10 Uhr	**Technische Vertragsbedingungen in der Horizontalbohrtechnik - DIN ATV 18324** Dipl.-Ing. (EWE) Hermann Lübbers, Beermann Bohrtechnik GmbH
11.30 Uhr	**DCA Richtlinien 2015 - Vorstellung der Neuerungen, Erläuterungen** Dipl.-Ing. Marc Schnau, Bohlen & Doyen GmbH
11.50 Uhr	**Marseille ein Streifzug durch die Historie** Corinne Sémarciyan
12.30 Uhr	**Diskussion**

13.00 Uhr	**Mittagessen** im Hotel Villa Massalia
14.00 - 18.00 Uhr	**Besichtigung Marseille „Europort“**
19.00 Uhr	**Treffpunkt Hotel-Lobby**
19.10 Uhr	**Abfahrt zur Abendveranstaltung**
19.30 Uhr	**Begrüßung am Strand im “Espace Borely”**
20.00 Uhr	**Abendveranstaltung im “Marseille style” am Strand im “Espace Borely”**

Freitag, 09. Oktober 2015

09.00 Uhr	**Spülungsaufbereitung mit Blick auf die Europäische Normung** Pierre Godillon, Clamens SA
09.30 Uhr	**Vollschnittbohrlochaufweitung - Neues Bohrwerkzeug steigert die Leistung von HDD im Festgestein** Dipl.-Ing. (FH) Michael Lubberger, Herrenknecht AG
10.00 Uhr	**Die NF P 94-500 Norm (französische Norm) als Grundlage für geotechnische Untersuchungen in HDD-Projekten** Dominique Feldmann, Forexi
10.30 Uhr	**Kaffeepause**
10.45 Uhr	**Brasilianische Meeresschildkröten „begutachten“ HDD im Gneis** Alexis Filliette, Projekst Manager, HDI
11.15 Uhr	**Alterung von Rohrleitungen in Europa - Austausch wann?** Jan Spiekhout, Ir, Executive Senior Advisor, DNV GL - Oil & Gas
11.45 Uhr	**Allt a Chonais – Bohrung in Festgestein zur Verlegung einer Wasserleitung** Jez Seamans, LMR Driiling
12.25 Uhr	Diskussion
12.45 Uhr	Tagungsende
13.00 Uhr	Mittagessen im Hotel Villa Massalia

www.fluxys.com

FLUXYS

Fluxys Belgium is the operator of the infrastructure for gas transmission, gas storage and terminalling of liquefied natural gas (LNG) in Belgium. The company has developed its infrastructure into a crossroads of international gas flows for northwest Europe. Its 4,100 km high pressure network is highly interconnected with all neighbouring networks and systems, providing access to all available natural gas sources for the European market.

Fluxys Belgium is an affiliate of Fluxys, a Belgium-based, fully independent gas infrastructure group present in 9 European countries. Besides its pipeline, storage and LNG terminalling assets in Belgium, Fluxys' partnerships include ownership in the Interconnector and BBL pipelines linking the UK with mainland Europe, the Dunkirk LNG terminal under construction in France, the NEL and TENP pipelines in Germany, the Transitgas pipeline in Switzerland, the Swedegas transmission and storage infrastructure in Sweden and the TAP pipeline from Turkey to Italy to be constructed so as to bring gas coming from Azerbaijan to Europe.

Fluxys Belgium ist der Infrastrukturbetreiber für Gastransport, Gasspeicherung und Terminalling von Flüssigerdgas (Liquefied Natural Gas - LNG) in Belgien. Das Unternehmen hat seine Infrastruktur zu einer Drehscheibe der internationalen Gasströme in Nordwesteuropa ausgebaut. Sein 4100 km langes Hochdrucknetz ist mit allen benachbarten Netzen und Systemen verbunden und bietet Zugang zu allen verfügbaren Erdgasquellen für den europäischen Markt.

Fluxys Belgium ist ein Tochterunternehmen von Fluxys, eine in Belgien ansässige, völlig unabhängige Gasinfrastrukturgruppe, die in 9 europäischen Ländern anwesend ist. Neben den Pipeline-, Lager- und Flüssiggas-Terminalling-Einrichtungen in Belgien umfassen Fluxys' Partnerschaften Anteile an den Interconnector- und BBL-Leitungen, die Großbritannien mit dem europäischen Kontinent verbinden, dem im Bau befindlichen Flüssiggas-Terminal Dünkirchen, den NEL- und TENP-Leitungen in Deutschland, der Transitgas-Leitung in der Schweiz, der Swedegas Übertragungs- und Lagerinfrastruktur in Schweden und der TAP-Leitung von der Türkei nach Italien, die errichtet werden soll, um Gas aus Aserbaidschan nach Europa zu befördern.

DCA

Sponsoring

www.grtgaz.com

GRTgaz is one of Europe's leading natural gas transmission companies and a world expert in gas grids and transmission systems. In France, GRTgaz owns and operates 32,150 km of underground pipelines and 27 compressor stations to transmit natural gas between suppliers and consumers (distributors or industrial firms directly connected to the transmission system).

GRTgaz performs a public service role in guaranteeing security of supply to consumers and sells transmission services to system users. A significant player in the energy transition process, GRTgaz is investing in innovative solutions to adapt its system and to reconcile competitiveness, security of supply and environmental protection. (www.grtgaz.com)

GRT Gaz ist eine der führenden europäischen Gastransportfirmen und ein weltweiter Experte für Gasnetze und Übertragungssysteme. In Frankreich besitzt und betreibt GRT Gaz 32.150 km Gaspipelines und 27 Verdichterstationen, um Gas zwischen Anbietern und Kunden zu übermitteln (Verteiler oder Industriefirmen sind direkt mit dem Verteilersystem verbunden).

GRT Gaz garantiert in der Öffentlichkeit Sicherheit in der Versorgung der Kunden und verkauft Übertragungssysteme an Systemnutzer. Das Unternehmen spielt eine wichtige Rolle im Energieübertragungsprozess, investiert in innovative Lösungen, um ihr System anzupassen und mit der Wettbewerbsfähigkeit, der Sicherheit der Versorgung und dem Umweltschutz in Einklang zu bringen. (www.grtgaz.com)

www.tigf.fr

TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE

Fully integrated into the industrial fabric, TIGF is a medium-size company which has been present in south-west France for 50 years. Providing large-scale transport and storage between producers and distributors, TIGF is the vital link in the gas supply chain.

TIGF has a network of more than 5,000 km of pressurised natural gas pipelines. At the crossroads of Europe, TIGF has an internationally strategic position: TIGF transports gas to the public distribution networks of the South West and to the rest of France.

TIGF provides the connections that guarantee the security of supply in Europe, under optimal competitiveness, quality and safety conditions. The transport activity enables shipping customers to transport natural gas capacities from one point to another on the network.

The gas may also be consumed in the area by public distribution or industrial sites directly connected to the network.

The storage activity regulates and adapts gas supplies for the entire TIGF network and part of the French networks.

INVESTING FOR TOMORROW

TIGF is committed to playing an important part in the development of gas exchanges and in increasing market fluidity. To ensure this, the company invests significant sums each year (137 million euros in 2014), particularly into projects to construct large scale gas transport pipelines to help improve fluidity in terms of Franco-Spanish interconnections (Béarn Artery, GIRLAND and the Adour Artery).

www.tigf.fr

TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE

Vollkommen integriert in das Industriegewerbe ist TIGF ein mittelständisches Unternehmen, das im Südwesten Frankreichs seit 50 Jahren präsent ist. Um lange Wege und Lagerung zwischen Hersteller und Anwender zu vermeiden, ist TIGF die lebenswichtige Verbindung in der Gasversorgungskette.

TIGF betreibt ein Netz von mehr als 5000 km Gasleitungen. An den Kreuzungspunkten in Europa hat TIGF eine international strategische Position: TIGF transportiert Gas zu den öffentlichen Netzverteilern im Südwesten und dem restlichen Frankreich.

TIGF stellt die Verbindungen her, die eine Versorgung in Europa garantieren, unter optimaler Wettbewerbsfähigkeit, Qualität und Sicherheitsbedingungen.

Die Beförderung ermöglicht Kunden mit Schiffen, Erdgaskapazitäten von einem Punkt zu einem anderen Netzwerk zu transportieren. Das Gas kann auch vor Ort über den Vertrieb oder über Industrieanlagen, die direkt mit dem Netzwerk verbunden sind, verbraucht werden.

Die Speicheraktivität reguliert und passt die Gasversorgung für das ganze TIGF Netzwerk und Teile der französischen Netzwerke an.

Investitionen für die Zukunft

TIGF ist verpflichtet, einen wichtigen Teil zur Entwicklung des Gasaustausches zu gewährleisten. Um dies sicherzustellen investiert die Firma große Summen jedes Jahr (137 Millionen Euros im Jahr 2014), besonders in Projekte, um in großem Maßstab Gastransportleitungen zu bauen, um die Absatzmöglichkeiten im Bereich der französisch-spanischen Verbindungen zu erhöhen (Béarn Verkehrsader, GIRLAND und die Adour Verkehrsader).

Roadbook

20th DCA-Europe Annual Congress Marseille 2015

Date	Time	Activity	Information
Wednesday 07/10/15	11^{30} - 18^{00}	Check-in on arrival at reception of hotel Villa Massalia, 17 Place Louis Bonnefon, 13008 Marseille, France	The rooms are free at 15^{00}. Luggage can be left in a separate room.
	13^{00}	Lunch at hotel Villa Massalia	Lunch is scheduled in the dinner room
	14^{50}	Meeting at the reception of hotel Villa Massalia	
	15^{00}	Discover Marseille – Le Panier and Notre Dame de la Garde	One German, two English groups
	18^{00}	End of sightseeing tour	
	19^{30}	"Cocktail reception" sponsored by hotel Villa Massalia	The reception is scheduled in the foyer meeting area or terrace depending on the weather
	20^{00}	Dinner at hotel Villa Massalia afterwards hotel bar	Dinner is scheduled in the dinner room; afterwards bar, open until 02^{00}

Date	Time	Activity	Information
Thursday 08/10/15	09^{00}	Congress Meeting	Main meeting room
	13^{00}	Lunch at hotel Villa Massalia	Lunch is scheduled in the dinner room

Roadbook

Date	Time	Activity	Information
Thursday 08/10/15	14^{00}	Departure to visit Marseille "Europort" Meeting point hotel lobby	Transfer by bus English speaking guide at the harbour visit
	15^{00} - 16^{30}	Visit Europort	
	17^{00}	Return to hotel Villa Massalia	Transfer by bus Arrival at the hotel 17^{45}
	19^{00}	Meeting at hotel lobby for departure	
	19^{10}	Walking tour to the beach	Walking distance 10 minutes
	19^{30}	Welcome on the beach side of „Espace Borély"	
	20^{00}	Dinner and evening on the beach in the „Marseille style"	
	01^{00}	End of event	Walking tour to hotel, the bar is open till 2^{00}

Roadbook

Date	Time	Activity	Information
Friday 09/10/15	**Until 12^{00}**	**Check-out from hotel Villa Massalia**	
	09^{00}	**Congress meeting**	**Main Meeting room**
	10^{30}	**Coffee break**	**Foyer area between exhibition**
	12^{45}	**End of congress**	
	13^{00}	**Lunch at hotel Villa Massalia**	**Lunch is scheduled in the dinner room**

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

Roadbook

20th DCA-Europe Annual Congress Marseille 2015

Social Program

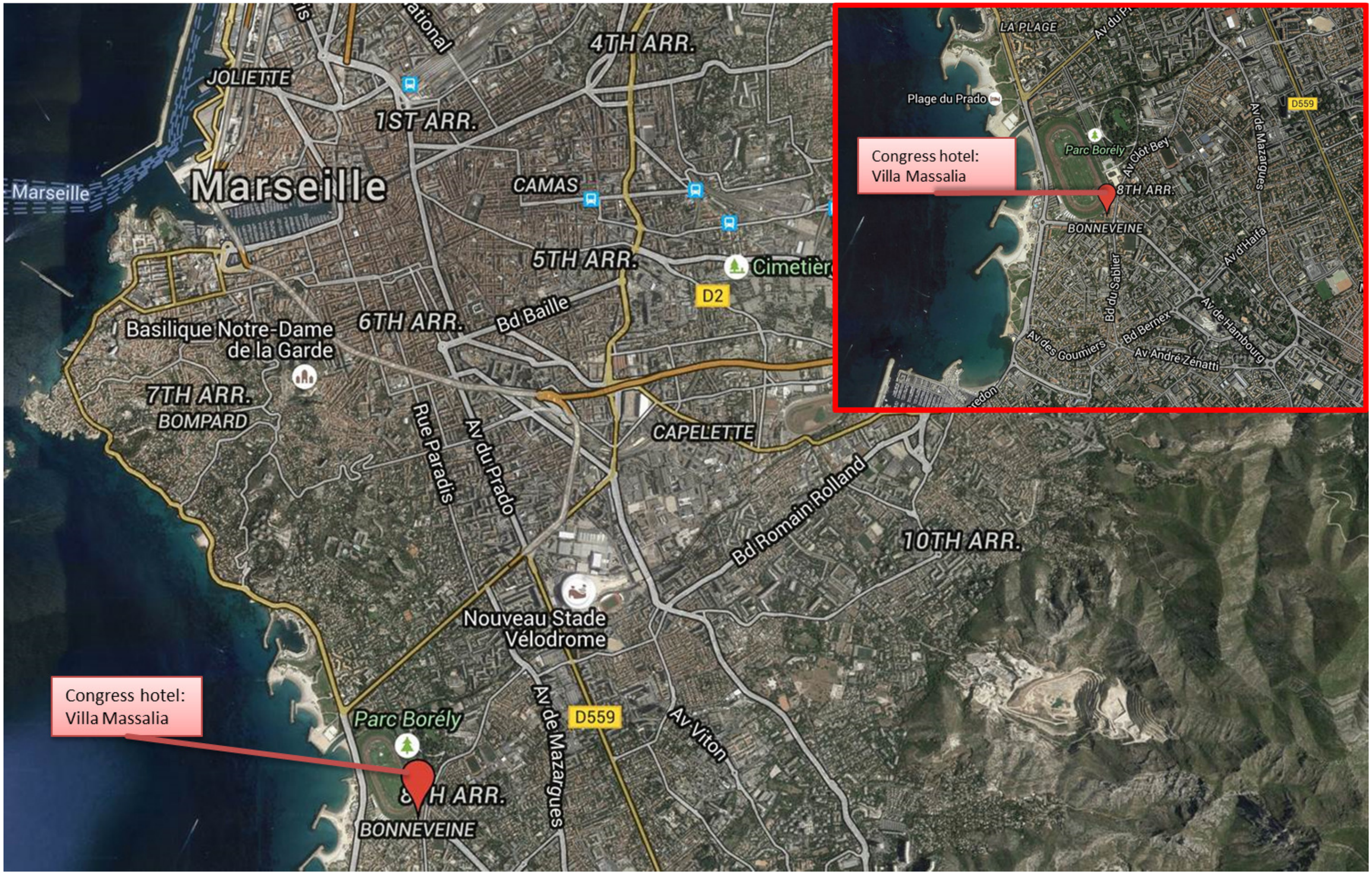
Date	Time	Activity	Information
Wednesday 07/10/15	11^{30} - 18^{00}	Check-in on arrival at reception of hotel Villa Massalia, 17 Place de Louis Bonnefon, 13008 Marseille, France	The rooms are free at 15^{00}. Luggage can be left in a separate room.
	13^{00}	Lunch at hotel Villa Massalia	Lunch is scheduled in the dinner room
	14^{50}	Meeting at the reception of hotel Villa Massalia	
	15^{00}	Discover Marseille – Le Panier and Notre Dame de la Garde	One German, two English groups
	18^{00}	End of sightseeing tour	
	19^{30}	"Cocktail reception" sponsored by hotel Villa Massalia	The reception is scheduled in the foyer meeting area or terrace depending on the weather
	20^{00}	Dinner at hotel Villa Massalia afterwards Hotel bar	Dinner is scheduled in the dinner room; afterwards bar, open until 02^{00}

Roadbook SP

Date	Time	Activity	Information
Thursday 08/10/15	8^{45}	Meeting in the hotel foyer with the tour guide	
	9^{00} - 16^{00}	Visit of Aix-en-Provence and wine tasting	Tour by bus
	19^{00}	Meeting at hotel lobby for departure	
	19^{10}	Walking tour to the beach	
	19^{30}	Welcome on the beach side of „Espace Borély“	
	20^{00}	Dinner and evening on the beach in the „Marseille style“	
	1^{00}	End of event, Bar hotel Villa Massalia	Walking tour to hotel, the bar is open till 2^{00}

Date	Time	Activity	Information
Friday 09/10/15	Until 12^{00}	Check-out from hotel Villa Massalia	
	13^{00}	Lunch at hotel Villa Massalia	Lunch is scheduled in the dinner room
	13^{00}	Golf tournament	Golf Club Golf d'Allauch Lunch packet will be arranged.

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


Marseille
JOLIETTE
1ST ARR.
4TH ARR.
CAMAS
5TH ARR.
D2
Cimetièr
Basilique Notre-Dame de la Garde
6TH ARR.
Bd Baille
7TH ARR.
BOMPARD
Rue Paradis
Av du Prado
CAPELETTE
Bd Romain Rolland
10TH ARR.
Nouveau Stade Vélodrome
Av de Mazargues
D559
Av Viton
Parc Borély
8TH ARR.
BONNEVEINE
Congress hotel:
Villa Massalia
LA PLAGE
Av du P
Plage du Prado
D559
Parc Borély
Av Clot Bey
Av de Mazargues
8TH ARR.
BONNEVEINE
Av d'Haifa
Bd du Sablier
Av des Goumiers
Bd Bernex
Av de Hambourg
Av André Zenatti
Congress hotel:
Villa Massalia

Teilnehmer der Jahrestagung 2015:

	Nachname	Vorname	Firma	Unterschrift
1	Bayer	Hans-Joachim	Tracto Technik	
2	Beermann	Ewald	Beermann Bohrtechnik GmbH	
3	Beermann	Steffen	Beermann Bohrtechnik GmbH	
4	Beerthuis	Frank	Vermeer	
5	Behmer	Antje	TDC Technical Duroplastic Constructions GmbH	
6	Bernas	Damien	MI-Swaco	
7	Bertolone	Vincent	Salzgitter Mannesmann Line Pipe GmbH	
8	Billig	Dan	Prime Horizontal	
9	Buhr	Gertrud	Steffel KKS GmbH	
10	Buhr	Klaus-Dieter	Steffel KKS GmbH	
11	Bunge	Sven	BTW Bohrtec-Teubner Wittenberg GmbH	
12	Butterworth	Jack	LMR Drilling GmbH	
13	Campbell	Melanie	Bau-ABC Rostrup	
14	Camps Querol	Jordi	Catalana de Perforacions S.A.	
15	Challet	Marie	FOREXI	
16	Clark	Ben	Derrick Equipment Company	
17	Copin	Jean Bernard	AIR LIQUIDE - EPS	

Teilnehmer der Jahrestagung 2015:

	Nachname	Vorname	Firma	Unterschrift
18	Cudeville	Amaury	Clamens	
19	Davrout	Jean-Luc	Tracto-Technik GmbH & Co. KG	
20	de Groot	Dion	SiteTec B.V.	
21	Dick	Philipp	MOLL-prd GmbH & Co. KG Planungsgesellschaft für Rohrvortrieb und Dükerbau	
22	Emonts	Marc	Kabelwerk Eupen AG	
23	English	John	Ditch Witch International - Barcelona	
24	Feldmann	Dominique	FOREXI	
25	Fengler	Ernst	LMR Drilling GmbH	
26	Filliette	Alexis	Horizontal Drilling International SA (H.D.I.)	
27	Fouque	Marie	Horizontal Drilling International SA (H.D.I.)	
28	Fredrich	Michael	Tief- und Rohrleitungsbau Wilhelm Wähler GmbH	
29	Gandard	Francois	Horizontal Drilling International SA (H.D.I.)	
30	Gardner	Barry	LMR Drilling UK Ltd.	
31	Gardner	Norma	LMR Drilling UK Ltd.	
32	Gendry	Jeremie	Gendry Service Location GSL	
33	Gendry	Sylvain	Gendry Service Location GSL	
34	Göbbels	Raphael	Kabelwerk Eupen AG	
35	Godillon	Pierre	Clamens	
36	Greve	Herrmann	Bau-ABC Rostrup	

Teilnehmer der Jahrestagung 2015:

	Nachname	Vorname	Firma	Unterschrift
37	Grossmann	Birgit	Bohrmeisterschule Celle	
38	Grossmann	Udo	Bohrmeisterschule Celle	
39	Hartung	Klaus-Dieter	Eigenbetrieb Abwasser der Stadt Hohen Neuendorf	
40	Hausmann	Hans-Wolfgang	LMR Drilling GmbH	
41	Hermsmeier	Mario	Beermann Bohrtechnik GmbH	
42	Herrenknecht	Simon	Herrenknecht AG	
43	Himmerich	Jörg	Dr.-Ing. Veenker Ingenieurgesellschaft mbH	
44	Huc	Dominique	American Augers, Inc.	
45	Huffman	Thorn	Tiger Trading, Inc.	
46	Irmscher	Frank	FMBE GmbH	
47	Irmscher	Simone	FMBE GmbH	
48	Jaguttis	Tim	de la Motte & Partner Ingenieurgesellschaft mbH	
49	Jorgensen	Brian	Ditch Witch International - Barcelona	
50	Ju	Lanqian	China Petroleum Pipeline Bureau (CPP)	
51	Kandora	Alexander	Vermeer Deutschland GmbH	
52	Kerkhoff	Peter	A. HAK Drillcon B.V.	
53	Khemiri	Atef	Horizontal Drilling International SA (H.D.I.)	
54	Kißing	Franz-Josef	Open Grid Europe GmbH	
55	Kissling	Franz	Vermeer Deutschland GmbH	

Teilnehmer der Jahrestagung 2015:

	Nachname	Vorname	Firma	Unterschrift
56	Knopf	Oliver	Phrikolat Drilling Specialties GmbH	
57	Kracht	Erhard	A. HAK Drillcon B.V.	
58	Kruse	Günter	LMR Drilling GmbH	
59	Landesberger	Norbert	TAU Ingenieurgesellschaft mbH Beratende Ingenieure und Geologen	
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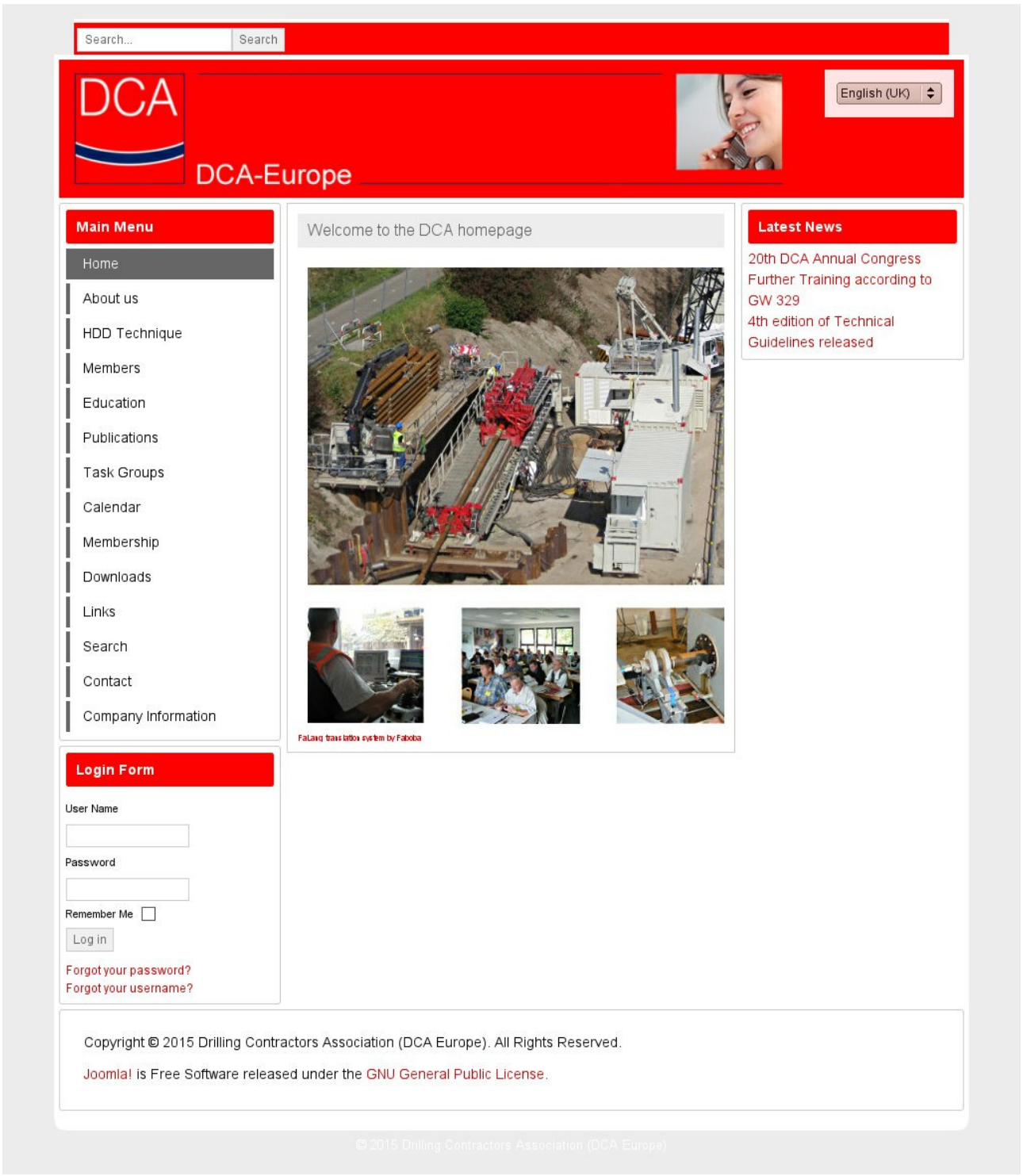

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HDD - savoir-vivre - in network and pipeline construction

Dear Mr. President,
My dear Ladies and Gentlemen,

I salute you with a hearty welcome to our **20th annual congress of the Drilling Contractors Association DCA** here in Marseille on the Côte d'Azur.

After last year's congress, the DCA decided to hold its 20th annual congress once more in France, after Berlin in 2013 and Düsseldorf in 2014.

I am especially pleased that this congress here in Marseille is again very well attended by more than 110 participants, and that many member companies of the DCA but also some interested non-members joined us. On behalf of the board I would like to thank you all for your coming.

Some of you might wonder why we chose Marseille this year as venue of the 20th annual congress. This town can surely win us over with its pleasant Mediterranean climate, owing to its location at the Mediterranean Sea. Much more important, however, is the title the town has achieved: Marseille is a dazzling cultural capital with a rich and unique historical heritage and a vivid culture. Being a gateway to Africa or Europe, Marseille is able to connect the two continents.

Our association, too, is able to make such connections; connections between HDD companies and all those who are also active on the market in Europe, partly even between companies from Europe and beyond; connections between companies on one side, and also between people on the other side. These connections always become obvious at our events that are characterized by the participation of numerous faithful members.

Another conjunction could be completed last week successfully: the fourth edition of the association's Technical Guidelines is no longer only available in German, but also in English and French now. This important bridge between the European member companies of the DCA now presents the state of the art.

Our congress motto this year is

HDD - Savoir-vivre - in network and pipeline construction"

It aims to establish, cultivate and support any "reliabilities" - or literally "good manners" - within the industry. An essential prerequisite is that consistent standards according to the association's statutes are observed. Openness on one side and standards on the other have to be brought in line, and this is not always easy. But I am sure that the DCA and its members are on the right track to fill this high demand imposed on ourselves with life again and again.

And now I would like to welcome all lecturers of this year's congress. Representing them I firstly greet Mr. Josselin Nivet of TIGF from France. Mr. Nivet will open the congress with his lecture about "TIGF's trust in the future". Welcome!

Right afterwards, Ms Carmen Rodriguez of ENTSOG (European Network of Transmission System Operators for Gas) will hold a lecture about the issue "10-year-network development plan (TYNDP) for Europe 2015". Ms Rodriguez, welcome to Marseille!

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And of course I welcome all members of the DCA, and like every year the new ones in particular. Welcome to the DCA-family!

Furthermore I would like to greet all guests that want to use this congress in Marseille as an opportunity to inform themselves about innovations in the HDD technology. This is also the chance to make contacts within the industry. Welcome to you as well!

Let us return to our congress this year and have a look at the programme for the coming two days.

After the two lectures I have already mentioned, our president Hermann Lübbers will deliver a brief insight with his report about the new standard DIN ATV 18324. It is a project that kept the DCA very busy in Germany in the past years, but it could be successfully completed now. Subsequently board member Marc Schnau will present to you DCA's guideline of 2015; he will go into the improvements in the fourth edition in particular.

Right before the lunch break, Ms Corinne Sémarciyan will provide some insight into history and today of Marseille. Lunch will be followed by the visitation of Marseille's harbour "Europort". You will receive some important information in this respect at the end of this morning.

As usual we will hear lectures about current HDD projects and other issues from the field of industry on tomorrow's Friday.

Concluding my brief introduction I wish you and all of us some interesting lectures of professionally top-class, open and crucial discussions and an eventful stay at the Côte d'Azur.

Yours,

Dipl.-Geol. Dietmar Quante
DCA - Executive-Secretary

HDD - savoir-vivre - in network and pipeline construction

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

ich möchte Sie alle recht herzlich zur **20. Jahrestagung des Verbandes Güteschutz Horizontalbohrungen e.V. (DCA)** hier in Marseille an der Cote d'Azur begrüßen.

Der DCA hat im Nachgang der letztjährigen Veranstaltung entschlossen, nach den beiden Veranstaltungen in Berlin 2013 und Düsseldorf 2014, die 20. Jahrestagung wieder in Frankreich durchzuführen.
Ich freue mich daher besonders, dass auch diese Jahrestagung hier in Marseille wieder mit über 110 Teilnehmern sehr gut besucht ist und viele Mitgliedsfirmen des DCA, aber auch interessierte Nichtmitglieder zu uns gekommen sind. Im Namen des Vorstandes möchte ich mich daher recht herzlich bei Ihnen allen für Ihr Kommen bedanken!

Warum wurde Marseille als Tagungsort für die 20. Jahrestagung ausgewählt, werden sich vielleicht viele von Ihnen fragen. Natürlich besticht der Ort durch sein mildes mediterranes Klima, Ausdruck seiner Lage am Mittelmeer. Viel wichtiger ist jedoch der Titel, den die Stadt errungen hat: Marseille ist eine schillernde Kulturhauptstadt mit einem reichen einzigartigen historischen Erbe und einer lebendigen Kultur. Als Tor zu Afrika bzw. zu Europa schafft Marseille Verbindungen zwischen beiden Kontinenten.
Auch unser Verband schafft Verbindungen. Verbindungen zwischen HDD-Firmen und allen am Markt Beteiligten aus ganz Europa, teilweise auch zwischen nichteuropäischen Firmen und Europa. Verbindungen zwischen Firmen auf der einen Seite, aber eben auch zwischen Menschen auf der anderen Seite. Diese Verbindung zeigt sich auch auf unseren Veranstaltungen, die durch die Teilnahme einer Vielzahl an treuen Mitgliedern gekennzeichnet sind.

Eine weitere Verbindung konnte in der letzten Woche erfolgreich fertiggestellt werden. Die 4. Auflage der Technischen Richtlinien des Verbandes ist nach der deutschen Fassung nunmehr auch in englischer und französischer Sprache erhältlich. Eine wichtige Brücke zwischen den europäischen Mitgliedsfirmen des DCA konnte somit auf den neuesten technischen Stand gebracht werden. Unser diesjähriges Motto

HDD - Savoir-vivre - in network and pipeline construction"

zielt darauf ab, „Verlässlichkeiten" oder wörtlich genommen „gutes Benehmen" in der Industrie zu schaffen, zu pflegen und zu fördern. Hierzu ist die Einhaltung von einheitlichen Standards gemäß den Richtlinien des Verbandes unerlässlich. Offenheit auf der einen Seite, Standards auf der anderen Seite, gilt es in Einklang zu bringen, was nicht immer einfach ist. Aber ich bin mir sicher, dass der DCA und seine Mitglieder auf einem guten Weg sind, diesen selbstgesteckten Anspruch immer neu mit Leben zu füllen.

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Herzlich begrüßen möchte ich an dieser Stelle alle Vortragenden des diesjährigen Kongresses, stellvertretend hierzu begrüße ich zunächst Herrn Josselin Nivet von der Firma TIGF aus Frankreich. Herr Nivet wird den Kongress mit dem Vortrag zum Thema „TIGF-Vertrauen in die Zukunft“ eröffnen. Herzlich willkommen!

Gleich im Anschluss wird Frau Carmen Rodriguez von der ENTSOG - European Network of Transmission System Operators for Gas - einen Vortrag zum Thema „10-Jahresnetzentwicklungsplan (TYNDP) für Europa 2015 halten. Frau Rodriguez, ebenfalls herzlich Willkommen in Marseille!

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!

Weiterhin möchte ich auch alle Gäste begrüßen, die die Tagung in Marseille 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!

Kommen wir nun zur diesjährigen Veranstaltung zurück und blicken auf das vorliegende Programm der nächsten beiden Tage.
Nach den zwei genannten Vorträgen wird unser Präsident Hermann Lübbers in seinem Vortrag einen kurzen Einblick in die neue DIN ATV 18324 geben. Ein Projekt, das den DCA in den vergangenen Jahren in Deutschland stark beschäftigt hat und nunmehr erfolgreich abgeschlossen werden konnte. Im Anschluss daran wird Vorstandsmitglied Marc Schnau in seinem Vortrag die DCA Richtlinie 2015 kurz vorstellen und insbesondere auf die Neuerungen in der 4. Auflage eingehen.
Vor der Mittagspause wird Frau Corinne Sémarciyan allen Teilnehmern einen Einblick in die Historie und das „Heute“ von Marseille geben. Nach der Mittagspause erfolgt dann die Besichtigung des Marseiller Hafens „Europort“ zu der wir Ihnen am Ende des heutigen Vormittags noch einige wichtige Hinweise mit auf den Weg geben werden.

Am morgigen Freitag finden wie gewohnt Vorträge zu aktuellen HDD-Projekten und zu weiteren Themen im Umfeld der Branche statt.
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 an der Cote d’Azur.

Ihr

Dipl.-Geol. Dietmar Quante
DCA - Geschäftsführung

HDD - savoir-vivre - in network and pipeline construction

Dear Ladies and Gentlemen, dear Colleagues,

I would also like to cordially welcome you to Marseille. Welcome to this beautiful town, welcome to our annual congress, welcome to the congress of the Drilling Contractors Association!

I really take much pleasure in welcoming so many friends, supporters and members of the association. Year after year we are worrying whether we will appeal to you with our programme or our choice of venue. Will we be able to reach you, will we reach our objectives to organise a congress booked to capacity? I must admit that we tried a lot in the past years since I have been responsible for the association. One or the other congress made me feel a bit queasy, could we really reach our goals? I am pretty proud that all events until now were successful, both in financial respects and in view of the participants' expectations! This shows us that we are on the right track with our issues, and that form and matter of our congresses measure up to your expectations. Let us hope that we were again able to organise a successful congress.

Our association is primarily composed of drilling contractors, therefore the name "Drilling Contractors Association", DCA. To put it in a nutshell: many of you who are present here and now are competitors, contending day after day with each other for sought-after orders in a fierce market competition. The conditions for such orders did not exactly ameliorate in the last years. Therefore we are very pleased that we can bring together so many competitors every year! What is the secret behind this phenomenon?

Well, I think that the association's statutes already offer an explanation. We are exerting ourselves for the technology, for its further development, for common problems and troubles occurring in the field of directional horizontal drillings. These issues turn up at all our companies in varying forms. Our task groups, our guidelines can provide answers. Most of these answers, however, are found and exchanged here during the congress!

I admit that I know that some of you would prefer to force the pace in some issues. But I tell you, ladies and gentlemen, that often thoroughness comes before speed.

As we all know it from directional horizontal drilling, any issue we deal with has to face the same approaches, processing and eradication that involve certain correlations, dependencies and the like that have to be observed. The current situation around the issue disposal of drilling fluids can serve as example. About three years ago we, or I already addressed this issue at a members' meeting. Only few were willing to follow my thoughts, but today everybody can understand what I was talking about then!

All of a sudden everyone knows what this is all about, now that they are overrun by the issue's development. Many of those concerned think they have to blame the DCA for idleness in this matter, ladies and gentlemen, but this is not correct and should not be left uncommented.

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The DCA, however, does not aim to score with short-run approaches that merely have a reassuring effect but do not provide a solution to the problem. Instead we concentrated on the legal aspects of the problem, asked someone to explain us what the legislator actually is up to, and analysed the attitude of clients and contractors in this matter.

We had conversations with representatives of the Sonderabfall-Management Gesellschaft SAM (hazardous waste management society) in Mainz. This society is directly subordinate to the respective ministry in Rhineland-Palatinate. Furthermore conversations were held with the Department of the Environment in Hanover.

The Department of the Environment Hanover had already published a decree on this matter in June/August of this year. Whether we want to face up to it or not: we do have a problem with the disposal of drilling fluids and drilling cuttings. If we look at the laws, this problem has been existing for some time now. We just did not internalise it, and the respective controls by the authorities were just not exercised, to simplify it.

In 2002, DCA‘s Sponsorship Award went to Mr. Markus Lappke of Fachhochschule Oldenburg. The title of his thesis was

“Bewertung des Umwelteinflusses von HDD-Spülungen“ (assessment of environmental stress by HDD drilling fluids)

Ladies and gentlemen, we may not act now as if we did not know anything about all that! This thesis, sponsored by the DCA, had already put down in words what we are discussing now.

Coming to the point we can proceed assuming the following facts:

- ► Bentonite mixed with water is without problems; in this form it is a product that fits into the fertiliser regulations.
- ► Bentonite mixed with water and subsoil poses a problem because we do not know which materials are brought into the liquid or solid phase. This fact obviously allo cates the responsibility for disposal or its costs to the client.
- ► Bentonite mixed with water, subsoil and additives also poses a problem! Here we have to pay more attention to the additives because they could push the problem of disposal more towards the contractor.

We want to have a professional discussion about this matter, not just see through rose-coloured glasses of “environmental soundness” onto all materials applied. Therefore the DCA invited to an informational day dedicated to answer all questions around this issue. Representatives of the ministry of environment and agriculture will stand up to your questions and hopefully clear up the whole matter on October 12, 2015. We were promised the willingness to find practicable solutions; even the readiness was signalized to cooperate actively in a task group.

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I would appreciate if we could all fly our flag und explain to the gentlemen from the ministry what our concerns are in view of this decree, documenting our fears resulting from it.

We are well aware that this date was closely fixed, but, my dear ladies and gentlemen, it is not so easy to make an appointment with representatives of a ministry for such an enterprise, to begin with; and secondly we want to deprive any criticism of fuel alleging the DCA would not attend to this problem. By all means, the DCA does attend to it, and everybody involved should support us in this matter. Going rogue helps no one; only together we are strong and can make headway!

If I wanted to paint a gloomy picture, I should say perhaps “the existence of directional horizontal drilling is at stake”, but we are not anywhere close to this point yet.

Let us return to the congress, to our programme. Two days are ahead of us, peppered with very good lectures, two days that will present us the world of the directional horizontal drilling technique from the most varying perspectives. As it is common practice we will have a lot of discussions about different issues, create new ideas and of course take all this with us home. Please help us to achieve sustained success of the congress with your contributions and incitements concerning the individual items of the programme. I thank you in advance for that!

Dear colleagues, these suspensions form the basis of our daily work – and this shall definitely remain so in future!

Hereby I open the 20th annual congress and wish you all a good time here in Marseille. Please feel free to contact me or one of my board colleagues in any matter during the breaks or in the evening.

Thank you very much for your attention
Marseille in October 2015

Hermann Lübbers
DCA President

Sehr geehrte Damen und Herren, liebe Kolleginnen und Kollegen!

auch ich begrüße Sie auf das allerherzlichste hier in Marseille. Willkommen in dieser wunderschönen Stadt, willkommen auf unserer Jahrestagung, willkommen auf der Jahrestagung des Verbandes Güteschutz Horizontalbohrungen e.V..

Es ist mir eine große Freude wieder so viele Freunde, Anhänger und Mitglieder des Verbandes begrüßen zu können. Jedes Jahr fragen wir uns wieder, erreichen wir mit dem ausgearbeiteten Programm und dem ausgewählten Tagungsort das Publikum, erreichen wir Sie, erreichen wir das gesteckte Ziel, eine voll ausgelastete Veranstaltung auf die Beine zu stellen. Ich muss gestehen, während der letzten Jahre wo ich die Verantwortung für den Verband getragen habe haben wir vieles ausprobiert, bei der einen oder anderen Tagung war mir schon mal etwas mulmig zu Mute, ob das gesteckte Ziel auch tatsächlich realisiert werden könnte. Es erfüllt mich mit einem gewissen Stolz, das bis dato alle Veranstaltungen das gesteckte Ziel jeweils erreicht haben, sowohl finanziell wie in der Zufriedenheit der Teilnehmer! Uns zeigt es, dass wir mit unseren Themen richtig liegen, dass wir mit der Art und der Form des Kongresses ihre Erwartungen erfüllen. Hoffen wir, dass wir auch dieses Jahr einen erfolgreichen Kongress gestalten werden.

Unser Verband besteht zum größten Teil aus Bohrunternehmen, so genannten Kontraktoren, deshalb auch der Name „Drilling Contractors Association“, DCA. Auf den Punkt gebracht heißt das, viele der hier Anwesenden sind untereinander Wettbewerber, kämpfen jeden Tag um begehrte Aufträge auf einen hart umkämpften Markt. Die Rahmenbedingungen für eben solche Aufträge sind in den letzten Jahren nicht gerade besser geworden, deshalb ist es für uns umso schöner, jedes Jahr wieder so viele Wettbewerber zusammenführen zu können! Wo liegt das Geheimnis für dieses Phänomen, für diese Tatsache?

Nun, ich glaube, die Satzung des Verbandes gibt bereits die Antwort. Wir bemühen uns um die Technologie, um die Weiterentwicklung, um die alltäglichen Probleme und Sorgen, welche in der Horizontalbohrtechnik anfallen. Diese Fragestellungen tauchen bei jedem von uns in der einen oder anderen Form auf, unsere Arbeitskreise, unsere Richtlinien geben bzw. können Antworten geben, die meisten Antworten werden jedoch hier auf dem Kongress gefunden und auch ausgetauscht!

Ich gebe zu, dem einen oder anderen geht es bei dem einen oder anderen Thema vielleicht auch zu langsam. Meine Damen und Herren, Gründlichkeit kommt in diesen Fällen vor Schnelligkeit.

Wie in der Horizontalbohrtechnik selber, ist es auch bei der Herangehensweise, der Aufbereitung und Abarbeitung eines Arbeitspunktes so, dass es immer gewisse Zusammenhänge, Abhängigkeiten und dgl. gibt, die es zu beachten gilt. Die aktuelle Situation bei dem Thema Spülungsentsorgung möchte ich gerne als Beispiel anbringen. Vor ca. 3 Jahren haben wir, habe ich

die Problematik bereits auf einer Mitgliederversammlung angesprochen, nur wenige wollten meinen Gedanken folgen, heute aber verstehen alle wovon seinerzeit die Rede war!
Jetzt weiß plötzlich jeder, weil er von der Entwicklung überrollt wurde, um was es hier geht. Viele der Betroffenen glauben dem DCA Untätigkeit auf diesem Feld vorwerfen zu müssen, meine Damen und Herren, das ist so nicht korrekt und sollte so auch nicht stehen gelassen werden.

Der DCA hat jedoch nicht die Idee, mit kurzfristigen Lösungsansätzen, die eher der Beruhigung als der Lösung des Problems dienen, zu punkten. Wir haben uns der rechtlichen Seite der Problematik zugewandt, haben uns erklären lassen was der Gesetzgeber eigentlich im Schilde führt und haben die Stellung des Auftraggebers sowie des Auftragnehmers in dieser Angelegenheit beleuchtet.

Wir haben Gespräche mit Vertretern der Sonderabfall-Management Gesellschaft SAM in Mainz geführt. Die Gesellschaft ist direkt dem entsprechenden Ministerium in Rheinland Pfalz unterstellt. Daneben wurden Gespräche mit dem Umweltministerium in Hannover geführt.
Das Umweltministerium Hannover hat bereits im Juli/August dieses Jahres einen Erlass zur besagten Thematik herausgegeben. Ob wir es nun wissen wollen oder nicht, wir haben ein Problem mit der Entsorgung der Bohrflüssigkeit wie auch mit dem Bohrklein. Rein gesetzlich gibt es dieses Problem schon etwas länger, weil es das entsprechende Gesetz auch schon länger gibt. Es wurde bis dato nur nicht gelebt, die entsprechenden behördlichen Aufsichten haben vereinfach gesagt, nicht stattgefunden.

Der DCA-Förderpreis ging 2002 an Herrn Markus Lappke von der Fachhochschule in Oldenburg. Der Titel lautete

„Bewertung des Umwelteinflusses von HDD-Spülungen“

Meine Damen und Herren, wir dürfen jetzt nicht so tun, als wenn wir all das nicht gewusst hätten! In dieser vom DCA geförderten Diplomarbeit wurde bereits all das was wir jetzt diskutieren, schriftlich nieder gelegt.

Auf den Punkt gebracht können wir von folgenden Fakten ausgehen:

- ► Bentonit mit Wasser vermischt ist kein Problem, es ist in dieser Form ein Produkt was in die Düngemittelverordnung passt.
- ► Bentonit mit Wasser und Baugrund vermischt stellt ein Problem dar, weil wir nicht wissen welche Stoffe in die flüssige oder auch feste Phase eingebracht werden. Diese Tatsache siedelt das Entsorgungsproblem bzw. die Entsorgungskosten wohl eher bei den Bauherren an.
- ► Bentonit mit Wasser, Baugrund und Additiven stellt ebenfalls ein Problem dar! Hier haben wir uns verstärkt um die Additive zu kümmern, denn Sie könnten die Entsorgungsfrage wieder in die Richtung des Bohrunternehmers rücken.

Um all dieses Mal fachlich und nicht nur durch die rosarote Brille der „Umweltverträglichkeit“ aller eingesetzten Stoffe zu besprechen hat der DCA zu einem INFO-Tag eingeladen auf dem alle Fragen rund um das Thema beantwortet werden sollen. Vertreter des Umwelt- und Landwirtschaftsministeriums werden Ihnen am 12.10.2015 Rede und Antwort stehen und hoffentlich alle Unklarheiten ausräumen. Man hat uns zugesagt, praktikable Lösungen in dieser Angelegenheit finden zu wollen und sogar Bereitschaft signalisiert sich an einem Arbeitskreis aktiv beteiligen zu wollen.

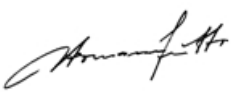
Es wäre schön wenn wir alle Flagge zeigen und den Herren aus dem Ministerium unsere Probleme mit dem herausgegeben Erlass erklären und unsere daraus resultierenden Ängste dokumentieren.
Es ist uns bewusst, der Termin ist sehr eng gesetzt, aber meine Damen und Herren, es ist erstens nicht ganz so einfach einen Termin mit Vertretern eines Ministeriums für ein derartiges Vorhaben zu realisieren und zweitens möchten wir auch den Vorwürfen Nahrung nehmen, der DCA kümmere sich nicht um dieses Thema. Der DCA kümmert sich und alle Beteiligten sollten uns in der Angelegenheit unterstützen und keine Alleingänge durchführen, nur gemeinsam sind wir stark und können in der Sache vorankommen!

Wenn ich schwarz malen würde, müsste ich vielleicht sagen „Es geht um die Existenz der Horizontalbohrtechnik“, aber so weit sind wir noch lange nicht.
Kommen wir zurück zur Tagung, zurück zu unserem Programm. Vor uns liegen zwei mit sehr guten Vorträgen gespickte Tage, zwei Tage die uns die Welt der Horizontalbohrtechnik aus den unterschiedlichsten Blickwinkeln erscheinen lassen wird. Wir werden wie immer, viele Diskussionen über das eine oder andere Thema führen, neue Ideen kreieren und natürlich auch mit nach Hause nehmen. Helfen Sie bitte durch Beiträge und Anregungen zu den einzelnen Programmpunkten mit den Kongress erneut zu einem Erfolg zu führen. Dafür bereits vielen Dank im Voraus!

Liebe Kolleginnen und Kollegen, diese Suspension stellt die Basis unserer täglichen Arbeit dar und das soll sie bitte schön auch bleiben!

Ich eröffne hiermit die 20. Jahrestagung und wünsche Ihnen allen eine gute Zeit hier in Marseille. Bei Fragen jedweder Art sprechen Sie mich oder einen meiner Vorstandsmitglieder gerne in den Pausen oder am Abend an.

Ich danke für Ihre Aufmerksamkeit
Marseille im Oktober 2015



Hermann Lübbers
DCA-Präsident

TIGF

Transport et Infrastructures Gaz France

DCA Presentation – Thursday the 8th of october 2015

20th DCA Annual Congress | Marseille 2015

Summary

TIGF, transport and storage of natural gas

- History, Geography, Situation, Network & Datas.
- Needs in Drillling and Strategy.
- Projects and Constructions 2015 and beyond.

TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE
HDD – Savoir – vivre – in network and pipeline construction

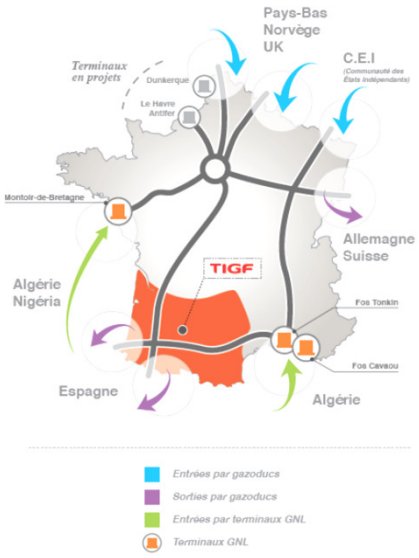
TIGF – Natural Gas Transport

A Strategic Situation

- TIGF is located in great southwest of France.
- Strategic situation of TIGF: between gas reserves of North Sea and Algeria.
- TIGF manages the transit with Spain.

Gaz context in progression

- Trading Region South creation, a new market place in the south of France.
- European Community Objective : gas interconnection development between Europe and North Africa.



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TIGF – the network

TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE
HDD – Savoir – vivre – in network and pipeline construction

TIGF - Datas (au 31 décembre 2014)

- **5 064 km of pipelines**, 14% of french natural gas network
- A network extended over **4 regions, 15 administrative areas, 1 200 communities.**
- **2 storages centers** (Lussagnet et Izaute),
- In France, **23% of gas storage capacity**
- **569 employees**

TIGF – Needs in drilling : TSOA

The TIGF network uses 170 briges across rivers and others specials obstacles.

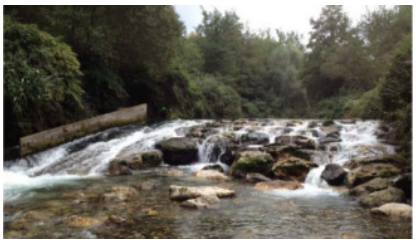
For safety reasons, these crossings can be abandonned and replaced by underground crossings oriented drillings.

Pipelines maintenance on bridges, floodings, boats trafic and reglementation encourage TIGF to replace these pipelines.

TIGF – Needs in drilling :TSCE

TIGF network crosses about 390 rivers, using underground construction (souille).

For erosion reasons, which generate some lack of depth and integrity issue.



Or for environemental reasons.

Those crossings can be replace by underground crossings oriented drillings.

TIGF – Purchasing Strategy

Project success = to meet initials planning and bugdet.

PREPARATION: to ensure the drill operation, TIGF performs some underground investigations (géophysic, géotechnic, soundings).

GARANTY: TIGF launch a first pre-call of tender to indentify futur bidders which are able to build an offer on lump sum based on the underground analysis. If resquested more underground inspection can be conducted.

CALL OF TENDER: The call of tender is send at all the companies which accept the fix price offer principe.

REX: TIGF is open to proposals to improve studies and constuction organisation.

TIGF –HSE and Reglementary Requirement.

Safety :

- TIGF HSE Agreement, Spécifique HSE offer,
- 12 gold rules respect, Personnal Safety Equipment, Safety Inductio

Environnement :

- Preliminary Investigation, Compensating measure, protections.

Parties prenantes :

- Respect Administrative TIGF Engagement.

Reglementary :

- Employment Law Respect (48 hours per week and an average of 44 hours for 12 weeks, 10 hours per day and 11 hours of rest between two posts, …)

TIGF – Projects and Constructions with drillings

2015

- A 96 km project containing 2 microtunnellings et 2 directional drillings.
- 8 projects of 26,8 km cumulated with 4 directional drillings.

2016

- 8 projects of 28,2 km cumulated with 2 directional drillings planed.

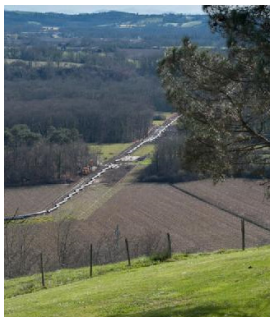
2017

- A 61 km project with 5 drillings to be determined.
- 6 planed projects of 4,5 km cumulated with 3 directional drillings.

TIGF – Projects and Constructions with drillings 2015

EDO DN600: 3 microtunnel & 2 FHD

- Microtunnellings for 2 rails crossings and a river « Gaves Réunis »,
- 2 directional drillings under 2 rivers « Bidouze » and « La Nive »,
- Grounds: Clay without cohesion. Stones and limestone dome below the « Gave Réunis »



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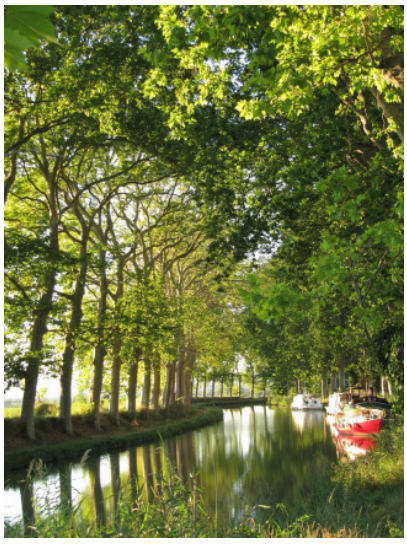
TIGF – Projects and Constructions with drillings 2015

3TSOA : 3 Oriented Drillings,

- The « canal du midi » is a 17eme century work,
- 3 crossings en DN80, DN100 & DN150
- Grounds: Marne (clay and limestone).



TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE
HDD – Savoir – vivre – in network and pipeline construction

TIGF – Projects and Constructions with drillings 2015

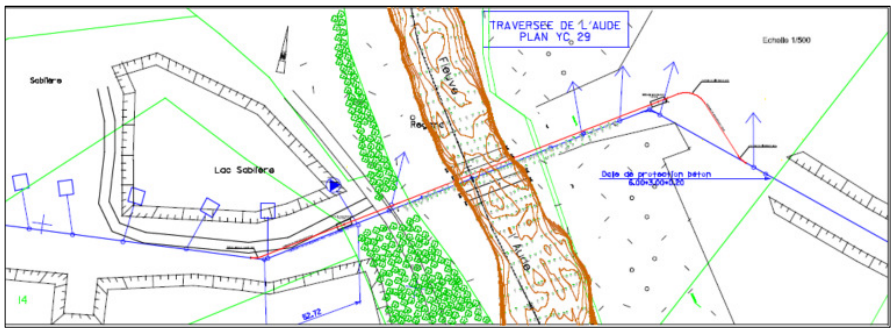
BERNAC : 1 Oriented Drilling, environnemental reasons.

- The « Adour » river : meander river, important flowding, crossed by a DN350 pipeline.
- Ground: Stones/Alluvium on 20 meters deep, marne below.

TIGF – Projects and Constructions with drillings 2016

AUDE : 1 Directional Drilling, 400 meters, DN300 pipeline.

- The « Aude » river for erosion reasons, the crossings will be built again.
- Grounds: alluvium layer of 6 to 8 meters and a heterogeneous molassic substratum below.



TIGF – Projects and Constructions with drillings 2016

CELE : 1 Directional Drilling.

- For erosion reasons, a 200 meters deviation of a DN80 pipeline.
- Grounds: Moderns alluvium on 7 to 10 meters deep, marl below.

TIGF – Projects and Constructions with drillings 2017

GRENADE, LAGOR, BIDOUZE : at least 3 Drillings

- Erosion and bridges crossings suppression
- DN80 to DN350
- Grounds investigation to be done in 2016.

TIGF – Projects and Constructions with drillings 2017/2018

RGM : 61km in DN900

- 5 crossings to be determined (rivers, rails).

TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE

TIGF

Transport et Infrastructures Gaz France

Présentation DCA – jeudi 8 octobre 2015

20th DCA Annual Congress | Marseille 2015

Sommaire

TIGF, transport et stockage de gas naturel

- Histoire, Geographie, Implantation, Réseau et Chiffres.
- Besoins en Forage et Strategy.
- Projets et Constructions (avec Forage) en 2015 et plus.

TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE
HDD – Savoir – vivre – in network and pipeline construction

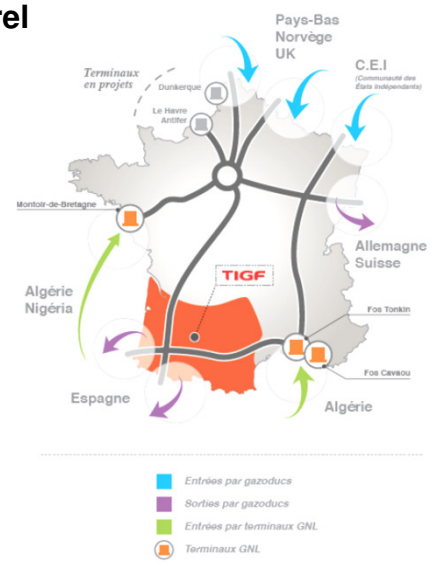
TIGF - transporteur de gaz naturel

Une situation stratégique

- TIGF est une entreprise implantée dans le **grand Sud Ouest** de la France.
- Situation avantageuse de TIGF : à mi-chemin entre les réserves de gaz de la **Mer du Nord** et celles d'**Algérie**.
- TIGF gère le transit avec l'**Espagne.**

Un contexte gazier en évolution

- Création de la TRS, une nouvelle place de marché **au sud de la France.**
- Objectif CE: Développement des interconnexions gazières **entre l'Europe et le Magreb..**



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TIGF – le Réseau

TIGF - Datas (au 31 décembre 2014)

- **5 064 km de canalisations**, 14% du réseau de transport de gaz naturel Français
- Un réseau étendu sur **4 régions**, **15 départements**, **1 200 communes**
- **2 sites de stockage** (Lussagnet et Izaute),
- En France, **23% des capacités de stockage** de gaz
- 49 **clients transport**, dont **11 clients stockage**
- **569 salariés** (CDI + CDD)

TIGF – Besoins en forage TSOA

Le réseau TIGF possède prêt de 170 traversées sur ouvrage d'Arts.

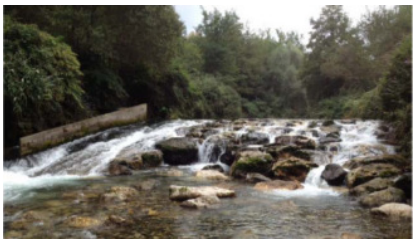
TSOA: Pour des raisons de sécurité industrielle, ces traversées sont parfois supprimées et remplacées par des traversées en sous profondeur (type Fonçage, FHD ou microtunnel).

L'entretien des ouvrages d'arts et les risques associés peuvent également inciter TIGF à abandonner les traversées aériennes.

TIGF – Besoins en forage TSCE

TIGF croise plus prêt de 390 cours d'eau en souterrain

Pour des raisons d'érosion, se traduisant par des défauts de sous profondeur et donc de d'intégrité du réseau



ou encore pour des raisons de discontinuité écologique,

ces traversées sont remplacées par des traversées en sous profondeur (type Fonçage, FHD ou microtunnel).

TIGF – Stratégie Forage

Garantir la réussite du projet = maintenir le planning et le budget.

PREPARATION: Afin de sécuriser l'opération de forage, nous réalisons nous-même les reconnaissances du sous-sols (géophysique, géotechniques, sondages).

GARANTIE: Nous pré-consultons les foreurs identifiés, afin de savoir si les résultats géologiques obtenus sont suffisant à la constitution d'offres forfaitaires. Dans le cas contraire des recherches complémentaires peuvent être entreprises.

CONSULTATION: Nous adressons l'Appel d'Offre aux entreprises de forage capable d'assurer une garantie de résultat ainsi qu'aux entreprises de pose de gazoduc.

REX: TIGF est à l'écoute de proposition permettant d'améliorer le déroulement des chantier et qui peuvent assurer la réussite des projets.

TIGF – Exigences HSE et Réglementaires.

Sécurité :

- Agrément HSE TIGF, Offre spécifique HSE,
- Respect des 12 règles d'or, EPI, Accueils Sécurité.

Environnement :

- Diagnostic préalable, mesures compensatoires, protections.

Parties prenantes :

- Respect Dossiers Administratif (Autorisation de Construire et Loi sur l'eau).

Réglementation :

- Respect du droit du travail (48h/semaine et 44h moyenne/12 semaines, 10h/jour et 11h de repos, , …)

TIGF – Projets et Constructions avec forages

2015

- Un projet de 96 km avec 2 microtunnels et 2 FHD (slide suivant)
- 8 projets de modification de 26,8 km cumulés dont 4 FHD

2016

- 8 projets de modification de 28,2 km cumulés dont 2 FHD prévus

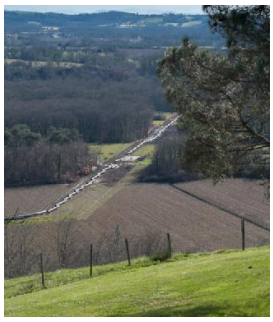
2017

- Un grand projet de 61km avec 5 forages à déterminer
- 6 projets prévus de 4,5 km cumulés dont 3 FHD prévus

TIGF – Projets et Constructions avec forages 2015

EDO DN600: 3 microtunnel & 2 FHD

- Micro 2 voies SCNF et les Gaves Réunis
- TSCE: Bidouze et La Nive en FHD
- Sols: Argile sans cohésion. Poches de galets et dôme calcaire sous les gaves réunis



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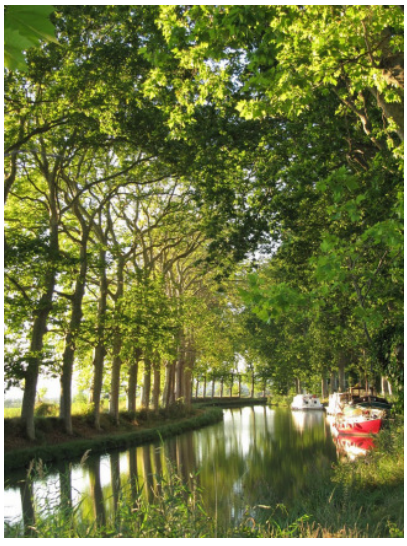
TIGF – Projets et Constructions avec forages 2015

3TSOA : 3 FHD, suppression des traversées aériennes

- Le canal du midi : un ouvrage du XVII siècle
- 3 traversées en DN80, DN100 & DN150
- Sols: Marnes argileuses et calcaires



TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE
HDD – Savoir – vivre – in network and pipeline construction

TIGF – Projets et Constructions avec forages 2015

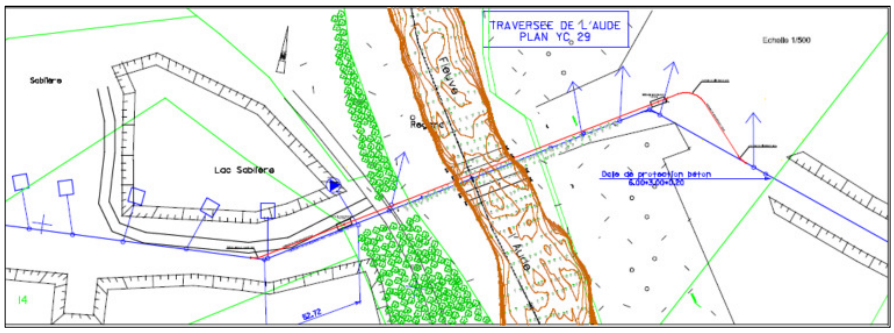
BERNAC : 1 FHD Suppression du seuil, environnement

- TECS de l'Adour: fleuve méandreux, subit des crues et inondations importantes, traversée en DN350,
- Sols: Alluvions/galets sur 20m de profondeur, puis marnes.

TIGF – Projets et Constructions avec forages 2016

AUDE : 1 FHD, 400m en DN300, érosion.

- TSCE de l'Aude: érosion, fleuve, traversée en DN300
- Sols: couverture alluvionnaire de 6 à 8m d'épaisseur, reposant sur substratum molassique hétérogène



TIGF – Projets et Constructions avec forages 2016

CELE : 1 FHD, 200m en DN80, érosion.

- TSCE du Célé: érosion du cours d'eau
- Sols: alluvions modernes sur 7 à 10m puis marne rocheuse

TIGF – Projets et Constructions avec forages 2017

GRENADE, LAGOR, BIDOUZE : at least 3 Drills

- Érosion et suppression de traversées aériennes
- DN80 to DN350
- Soils investigation to be done in 2016

TIGF – Projets et Constructions avec forages 2017/2018

RGM : 61km en DN900

- 5 traversées à déterminer (TSCE, SNCF).

TIGF TRANSPORT ET INFRASTRUCTURES GAZ FRANCE

ENTSOG Ten-Year Network Development Plan (TYNDP) 2015

The TYNDP 2015, produced by the European Network of Transmission System Operators for Gas (ENTSOG), is the fourth edition of the pan-European Ten Year Network Development Plan (TYNDP). The TYNDP 2015 covers an extended time period ranging from 2015 to 2035 and provides a wide view of how European gas infrastructure and supply adequacy could develop over the next two decades. The extension of the time horizon from 10 to 21 years has been done in order to comply with the Cost-Benefit Analysis (CBA) requirement of the TEN-E Regulation.

The regulatory requirement on ENTSOG to publish the Union-wide TYNDP every two years stems from the 3rd Energy Package. The original aims were to identify possible investment gaps and to assess the evolution of the supply adequacy. With the entry into force of the TEN-E Regulation in May 2013, the TYNDP has acquired a new dimension as it is now the first step of the Project of Common Interest (PCI) selection process. Every PCI candidate must submit its project to ENTSOG for inclusion in TYNDP. ENTSOG will then apply the Cost-Benefit Analysis (CBA) methodology, which has been developed for this TYNDP.

The development and maintenance of gas infrastructure supports the three pillars of the European energy policy: security of supply, competition and sustainability. It facilitates a liquid and hence a competitive internal gas market by increasing physical market integration. The resulting flexibility of the European gas system will enable and enhance supply diversification and Security of Supply, even in the case of declining indigenous production. Gas infrastructure will also play an important role in improving sustainability in the EU by helping to meet its environmental targets.

From projects to commissioned infrastructure

ENTSOG has received submissions for 259 projects from transmission, storage and LNG terminal promoters by the deadline of September 2014. The withdrawal of the South Stream project, approved by the promoter and the European Commission, is the only exception because of its possible major impact on the assessment. The project list includes the PCI resulting from the first selection and all candidates for the second round of the PCI assessment.

The number of projects is slightly lower than in the previous TYNDP edition, but there are still sufficient infrastructure projects to deliver market integration. While construction works are normally completed on time, the final investment decision for many projects is postponed. Therefore, ENTSOG asked promoters to identify the main challenges they have been facing.

The first barriers mentioned by promoters are related to various aspects of the regulatory frameworks. In some cases these stem from a lack of implementation of European regulation preventing a well-functioning market which is a major prerequisite for investment decisions. In other cases, some national frameworks are perceived as excessively focusing on the reduction of the regulated tariff, not

recognizing the economic benefits of further market integration and therefore granting insufficient rate of return.

The second group of barriers stems from a short term focus of the market which is not providing sufficient financial commitment. This is a result of the combination of an unfavourable economic environment with regulation, which is nowadays favouring the short term perspective. This can result in a higher reliance on other solutions, such as the socialization of cost or co-financing, and can lead to a higher risk of stranded assets.

One of the main reasons for this lack of market commitment is the uncertainty in the long term use of gas in definition of the European energy mix. Only a relative small share of investment can be triggered for security of supply reason. Market players, NRAs and infrastructure operators need the guarantee of sufficient use of the infrastructure in order to support the economically efficient development of projects.

A stable demand driven by global context

Since 2010 European gas demand has continuously decreased mainly due to a lower use of gas-fired power generation. This results from the combination of European policies, such as the development of renewable sources (RES) and an inefficient European Trading System (ETS), as well as the global context of low coal prices and still ongoing economic downturn.

The TYNDP assessment indicates that over the next two decades the evolution of gas demand is likely to be driven mostly by the use of gas in the power generation sector. Most gas demand outlooks evolve in a narrow range which depends on the equilibrium between gas, coal and CO2 prices. ENTSOG has developed two alternative scenarios for gas demand (Green and Grey). Both scenarios show a slow increase of gas demand (0.4% per annum on the next twenty-one years). The overall trend hides a heterogeneous situation among countries. This is particularly the case in the Green scenario due to very different national strategy to achieve environmental targets.

Nevertheless, divergent scenarios, showing long-term decrease of gas demand are the “DGENER trends to 2050” and the “IEA 450 S” where environmental targets are achieved with a higher level or RES and a better efficiency.

ENTSOG is now deriving the level of gas demand for power generation based on ENTSO-E and price data. The seasonal swing is now modelled through the use of summer and winter cases. ENTSOG has kept the 1-day Design Case and the 2-week Uniform Risk Case representing the extreme situation to be covered by the European gas system.

Europe needs to enlarge its supply portfolio

When gas demand does not show a clear evolution, the requirements for gas imports are driven by the decreasing indigenous production. Under the current perspective the induced need for additional imports is likely to be met by Russian gas and LNG. In such a situation Europe would be in a challenging position resulting in a reduced market power. Other sources are likely to stay at the current level (pipe gas from Algeria and Libya) or would only have a limited influence (Caspian gas) in absence of stronger market signals. Norway is a very particular case as there is a potential to deliver significant volumes from the Barents Sea gas fields from the mid 2020s. Nevertheless, the investments connecting this production to the existing European gas network is not yet decided and is in competition with potential LNG developments as a result of the lack of long term attractiveness of the continent. Other producers (e. g. North Africa and Middle-East) are facing the same challenges. Appropriate signals from Europe would enable the delivery of new supply to Europe improving both its energy security and its competitiveness while supporting high environmental standards.

Market integration, a constant challenge

The TYNDP assessment confirms a predominant position of Russian gas and LNG supplies even with all other sources at high deliverability. This situation could be improved with the commissioning of new infrastructure and the connection of new supplies.

TYNDP findings show that regions not sufficiently integrated often suffer from a lack of security of supply and competition. This is especially the case for the Baltic region, Central-Eastern and South-Eastern Europe, where the development of infrastructures has been insufficient due to the historical gas supply from Russia, and also for South-Western Europe where LNG has a significant role. The latter case is not an issue in terms of security of supply, but in terms of exposure to the global LNG price.

This situation may improve across Europe in the future if sufficient new investment decisions are taken. But the increasing need of imports and the predominance of Russian and LNG supplies could put Europe in a difficult situation despite the completion of market integration.

The analysis also shows that from a price perspective most of the supply sources may already have a large influence across Europe. The picture resulting from the assessment is influenced by the assumptions of a well-functioning markets and a single price per import source. Such assessment is not necessarily reflecting a physical access to import sources.

Only the development of new indigenous production such as biomethane, shale gas or new conventional fields can limit the need of additional imports.

Way forward

As in previous editions, this TYNDP confirms that market integration in Europe can be achieved if necessary projects are decided. From a regulatory perspective, such decisions will require a full and timely implementation of European regulation taking into consideration the economic benefit of well-developed infrastructures. These investment decisions will also require that energy policies recognize the role of gas in achieving high environmental targets in a cost-efficient way preserving European competitiveness. But there is actually a risk that these requirements might not be met. This will mean that some regions will stay isolated in Europe, and also, that necessary investments will not be realized endangering the situation for all Europe. ENTSOG will continue to offer a transparent and objective platform to stakeholders and institutions to assess the possible evolution of the European gas system and its contribution to the European energy policy. Therefore, you are invited to take part in the consultation process and to bring your own knowledge and vision for the development of gas infrastructures in Europe.

Content

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- Scenarios
  - Demand scenarios
  - Supply scenarios
  - Supply Adequacy Outlook
- Projects
- Network model
- Network assessment (only very basic)

2

HDD - savoir-vivre - in network and pipeline construction

Where it started and ENTSOG's role

Initial situation of European Gas Business: Trading barriers

- Heterogeneous gas businesses throughout Europe (competition, supply, …)
- High level of market protection (entrance barriers)
- Different legislative environments
- Little trading volume
- Huge gas price spreads between countries
- Lack of transparency

3rd Energy package: Regulation (EC) 715/2009

ENTSOG's role:

- Facilitate and enhance cooperation of national gas TSOs across Europe
- Promote completion and functioning of the internal European energy market and cross-border gas trading
- Ensure optimal management, coordinated operation and sound technical evolution of the natural gas transmission network

4

ENTSOGs Tasks

- **Pan-European Network Codes** cross-border/market integration issues

- Pan-European **Ten-Year Network Development Plan** ('TYNDP')
- Regular **gas supply/demand outlooks** on the European market
- Develop **common operational tools** (CNOTs): network security and reliability
- Providing **information/data** (Transparency Platform, maps)

ENTSOG recurrent deliverables

Mandatory publications under 3rd Energy Package since 2009

> 4 Ten Year Network Development Plans *(TYNDP 2015-35 published in April 2015)*

> 12 Summer and Winter Supply Outlooks

> Gas Regional Investment Plans to be published by TSOs with ENTSOG support

Voluntary publications

> Since 2011, ENTSOG publishes Seasonal Reviews analysing demand, supply and flows of the previous season

> Transmission Capacity Map focusing on capacity at Interconnection Point

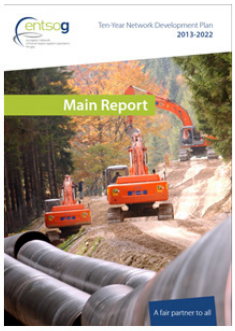
> System Development Map focusing on the supply and demand balance at European and country levels for the past year

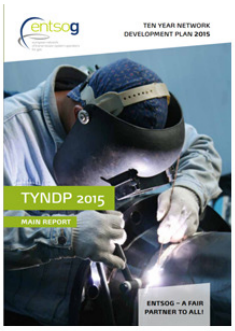
These deliverables are regularly consulted during their development process in order to meet increasing expectations from stakeholders

TYNDP

7

TYNDP: a continuous evolution



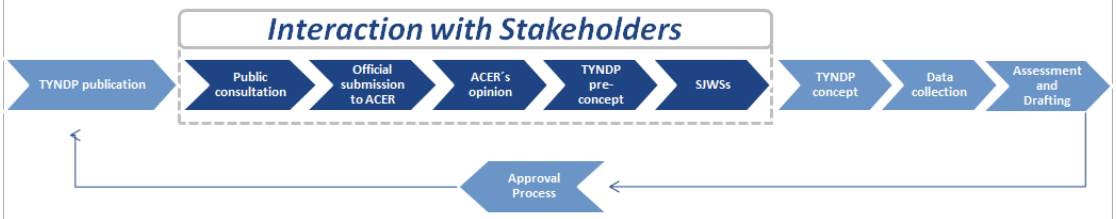


- Ten-Year Network Development Plan 2010-2019
- Ten-Year Network Development Plan 2011-2020
- Ten-Year Network Development Plan 2013-2022
- **Ten-Year Network Development Plan 2015**

8

TYNDP process

Continuous interaction with market participants



ENTSOG defines the modifications on the approach on the basis of the responses to the public consultation and ACER´s opinion. The details on the implementation of the new concept is defined through open discussion with stakeholders on the SJWSs.

9

TYNDP 2015 – Main content

Follow-up of the previous editions

- Multiple supply scenarios
- Demand scenarios: coverage of yearly evolution and demand modulation
  - Peak demand
  - 2-week peak
- Network modelling based on entry-exit zones
- TYNDP covers both normal conditions and supply disruptions

What's new?

- Moving from the 10-year to the 20-year horizon
- Two alternative demand scenarios
- Gas demand for power generation: consistency with ENTSOE
- Covering two alternative commodity and CO2 price scenarios
- CBA methodology. TYNDP as basis for the PCI selection.

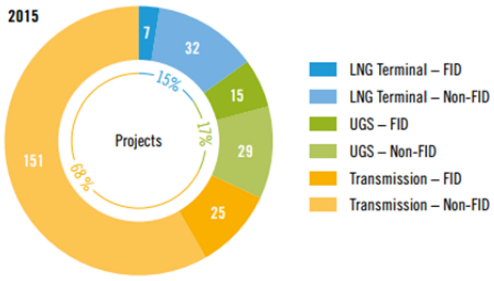
10

Projects

11

Project Statistics

Project numbers by Type and FID status



Transmission projects:
- 26.000 km pipelines
- 4.133 MW Compression power

UGS projects:
- 21.395 mcm WGV
- 435 mcm/d deliverability
- 325 mcm/d injection capacity

LNG projects:
- 22.680 mcm/d
- 7.418.000 m3 storage capacity

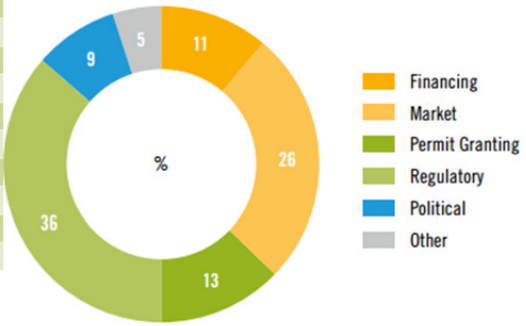
259 (47 FID)** in TYNDP **2015
Decrease in LNG and FID-TRA
181** projects **already** part of TYNDP **2013

12

II. Barriers to invest

The categories of barriers and their reported share...

REGULATORY	Rate of Return
	Low price of short term capacity
	Capacity quotas
	Lack of proper transposition of EU regulations
	Other
MARKET	Lack of market support
	Lack of market maturity
	Other
PERMIT GRANTING	
FINANCING	Availability of funds
	Amortization rates
	Other
POLITICAL	
OTHER	



61 out of 88** promoters in TYNDP have reported **at least one barrier
*The most often reported barriers originated from the **regulatory**- and **market frameworks***
The overal picture remains the same regardless of the type of infrastructure

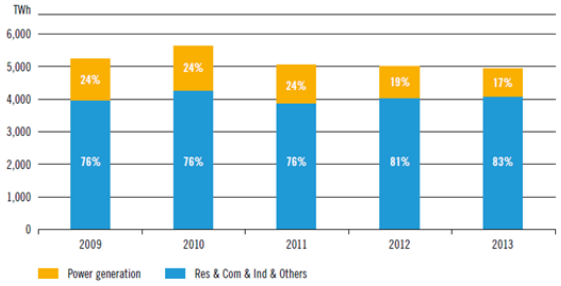
13

Scenarios

14

ENTSOG demand scenarios

Great uncertainty in the evolution of European gas demand



> Since 2010, European gas demand has followed a continuous decrease
  - Mostly caused by the power generation sector
  - Increase of RES in the generation mix
  - Coal replacing gas, following coal, gas and CO2 prices

> Is this trend to be sustained on the long term???

15

ENTSOG demand scenarios

Two divergent scenarios to cope with uncertainty

GREEN

DEMAND

- **FINAL GAS DEMAND:** Scenario A
  Favourable economic and financial conditions
- **POWER GENERATION:** *Vision 3 "Green Transition"**

PRICES

- **"Gone Green" from UK Future Energy Scenarios:**
- *High price of CO2 emissions*
- *Reduction in the oil-price linkage mitigating the increase of gas price when oil prices increase*

GREY

DEMAND

- **FINAL GAS DEMAND:** Scenario B
  Non-favourable economic and financial conditions
- **POWER GENERATION:** *Vision 1 "Slow Progress"**

PRICES

- **"Current Policies scenario" IEA WEO 2013:**
- *Low price of CO2 emissions*
- *Higher energy prices*

- At EU level, gas demand is higher under the Green scenario mainly due to the predominance of gas over coal in the power generation sector driven by the combination of coal, gas and CO2 prices.

* ENTSO-E's TYNDP vision

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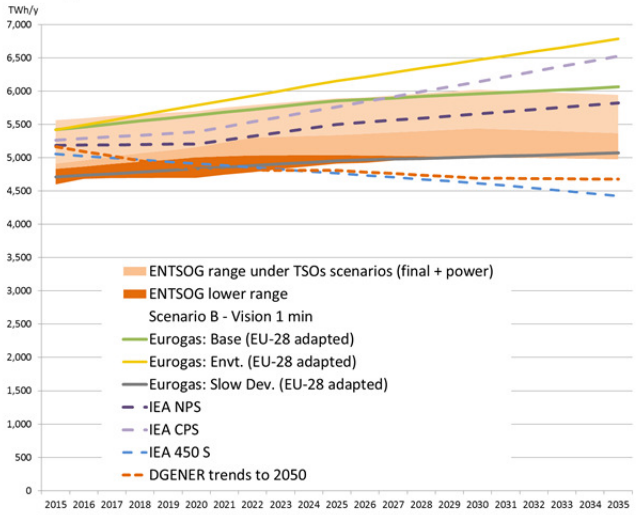
ENTSOG demand scenarios

Covering the range



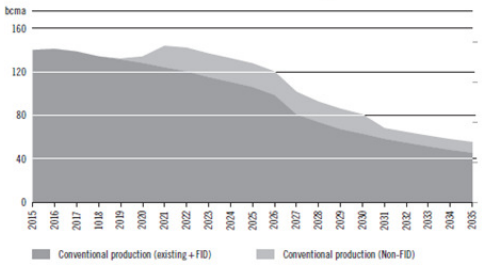
The range defined by the Green and the Grey demand scenarios covers most of the alternative scenarios analysed for the first half of the horizon, falling between divergent ones for the long term.

17

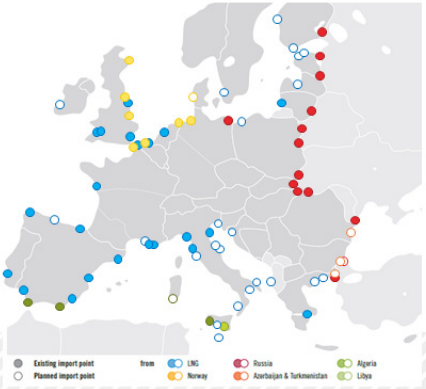
The basic blocks: Supply

Facing national production decline…

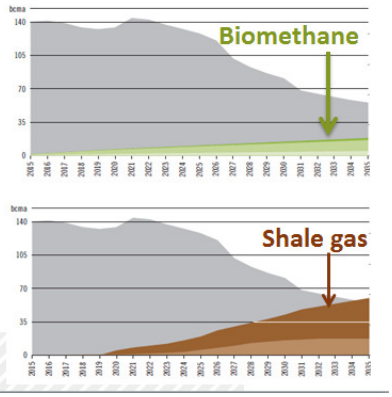
> Connection of Romanian Black Sea and Cyprus fields would mitigate the decrease



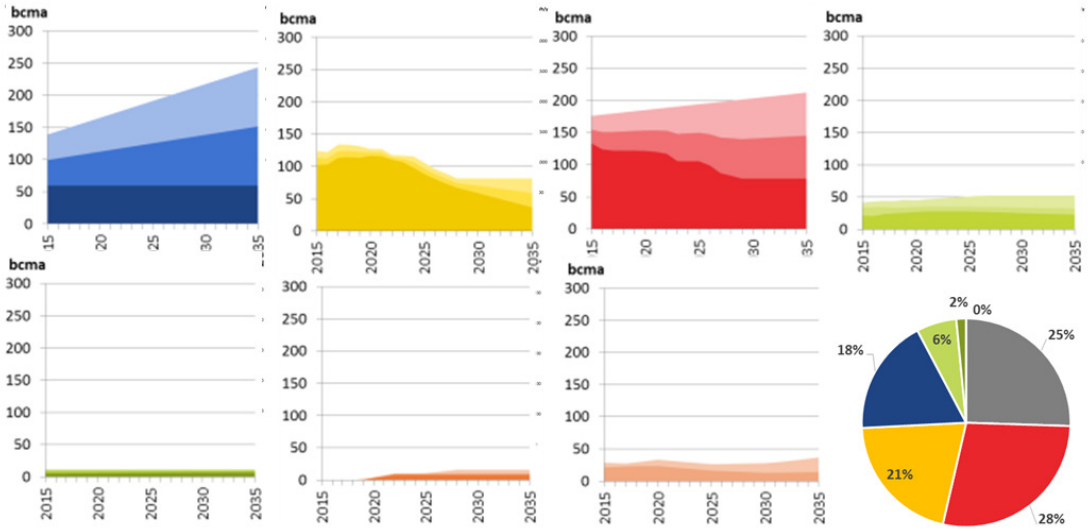
… Europe will have to develop new imports and indigenous production



This can materialize through the implementation of many projects of different sizes



Import sources



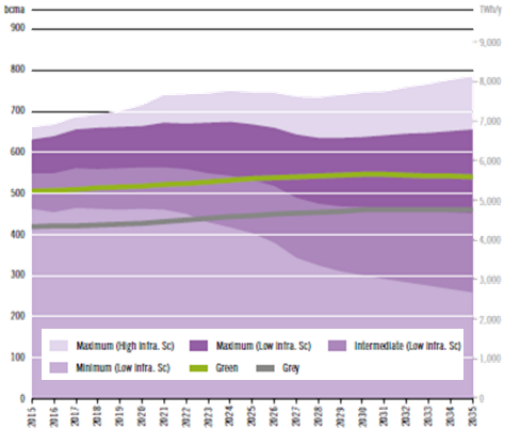
The decrease of European production can only be compensated by LNG or/and Russian gas

19

Supply adequacy outlook

Challenges ahead

- 2015-2025: under Grey scenario midstreamers may face issues in meeting ToP clausis
- 2025-2035: supply situation becomes tigther



Europe needs to enlarge its supply portfolio

- Without new supply and related infrastructure projects, Europe supply diversification will be put at risk

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Assessment

21

Assessment Structure

General Trends
- Potential Range of Supply Shares

Infrastructure Resilience
- Disrupted demand*
- Remaining Flexibility*
- Import Route Diversification
- N-1

Influence of supply sources
- USSD** (Uncooperative Supply Source Dependence)
- CSSD** (Cooperative Supply Source Dependence)
- SSPDe** (Supply Source Price Dependence)
- SSPDi** (Supply Source Price Diversification)

Monetization
- EU total bill
- GPI (Gas Price Index)
- Marginal Price

Annex E: 53 Mb of data

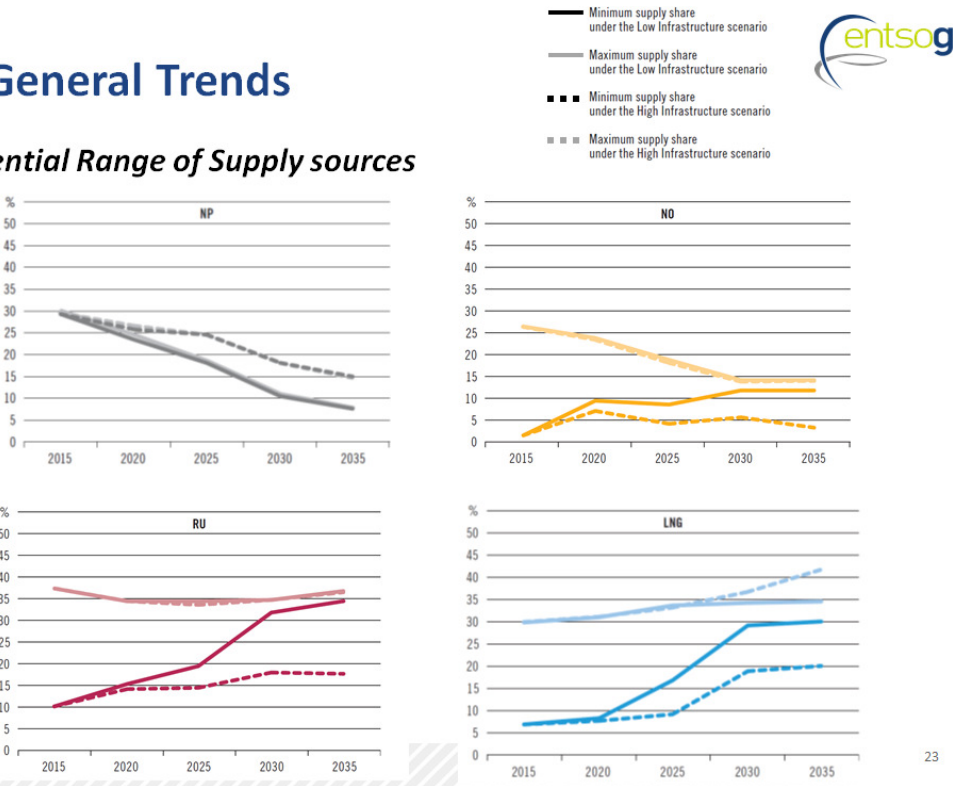
Name	Size
..	
entsog_TYNDP2015_annex_E2_Flows.xlsx	19,382,667
TYNDP022-150316_Annex_E1_Demand and CO2.xlsx	493,056
TYNDP022-150316_Annex_E3_Disrupted_Demand.xlsx	5,750,557
TYNDP022-150316_Annex_E4_Disrupted_Rate.xlsx	2,547,254
TYNDP022-150316_Annex_E5_Remaining_Flexibility.xlsx	2,811,539
TYNDP022-150316_Annex_E6_N-1.xlsx	266,781
TYNDP022-150316_Annex_E7_IRD.xlsx	581,052
TYNDP022-150316_Annex_E8_Modelling_Indicators.xlsx	4,094,792
TYNDP022-150316_Annex_E9_Monetization.xlsx	386,827
TYNDP022-150316_Annex_E10_GPI.xlsx	8,744,166
TYNDP022-150316_Annex_E11_Marginal_Price.xlsx	8,160,574

* Including disruption scenarios
** For each of the import sources

22

General Trends

Potential Range of Supply sources



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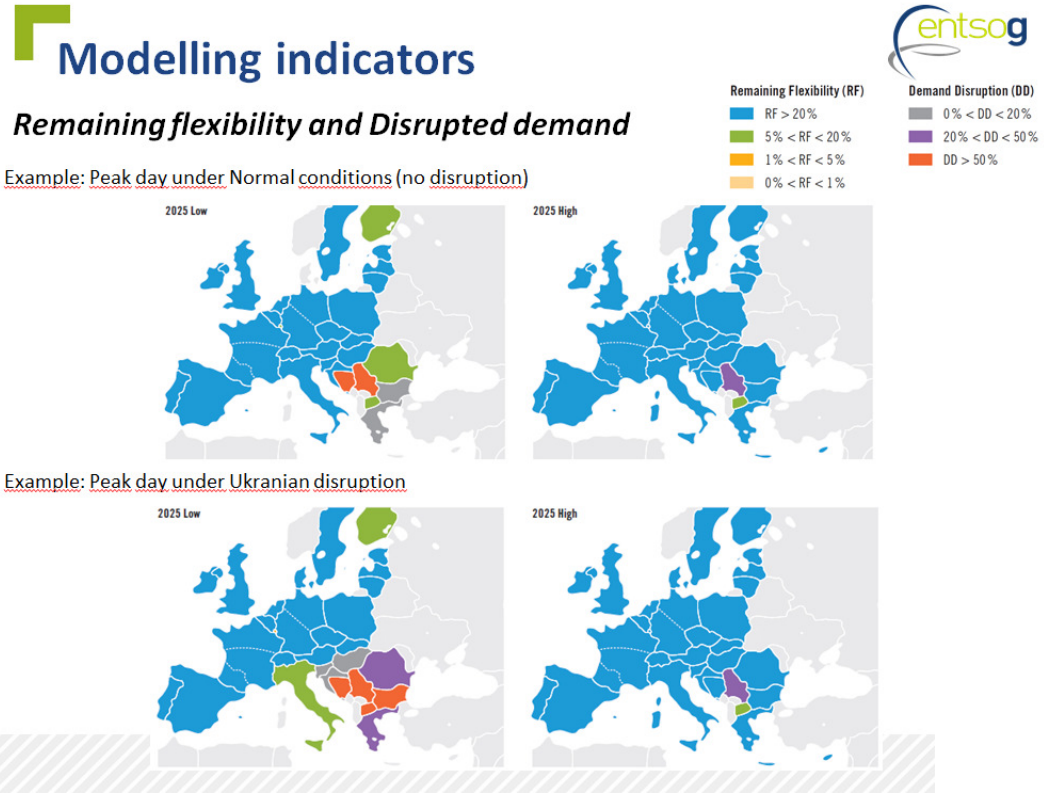
Modelling indicators

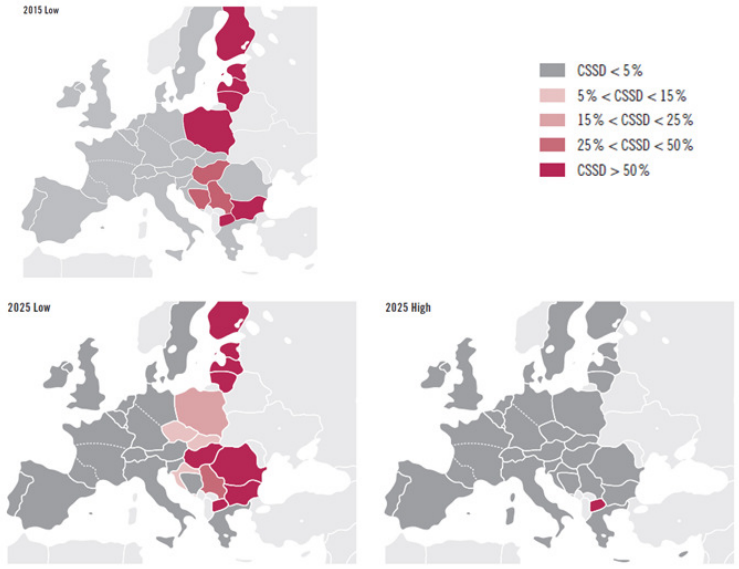
Remaining flexibility and Disrupted demand



Modelling indicators

entsog

CSSD for Russia



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Modelling Indicators

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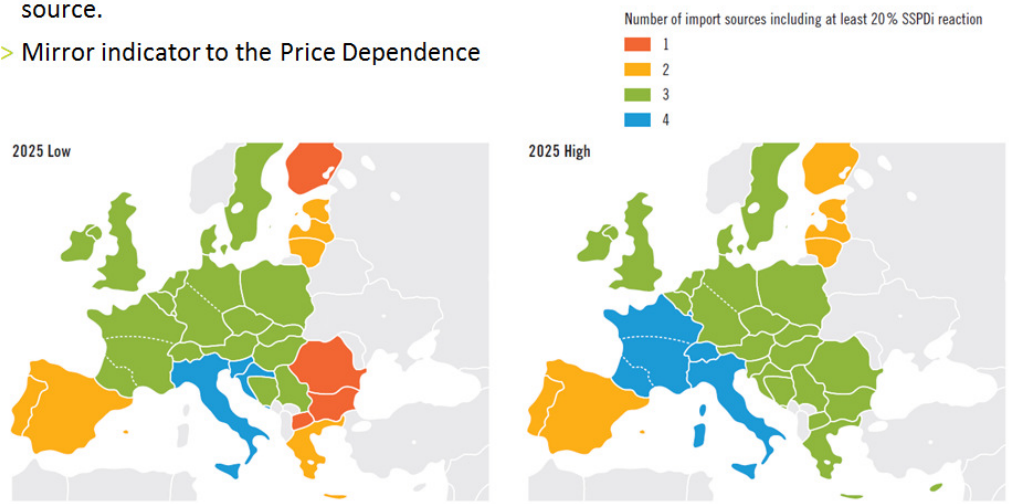
Supply Source Price Diversification (SSPDi)

> Measures the ability of each country to benefit from a decrease of price of each import source.

> Mirror indicator to the Price Dependence



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ENTSOG supports 2nd PCI selection

TYNDP 2015 is key

> Low Infrastructure Scenario allows the identification of investment gap

> It is the background against which PCI candidates are assessed

ENTSOG has handled for all PCI candidates the part of CBAs regarding benefits

> ENTSOG has used the TYNDP network modelling tool to calculate candidates' benefits

> The process ensures consistent benefits' assessment for all candidates

ENTSOG provides technical guidance to Regional Groups

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PS-CBAs scenarios

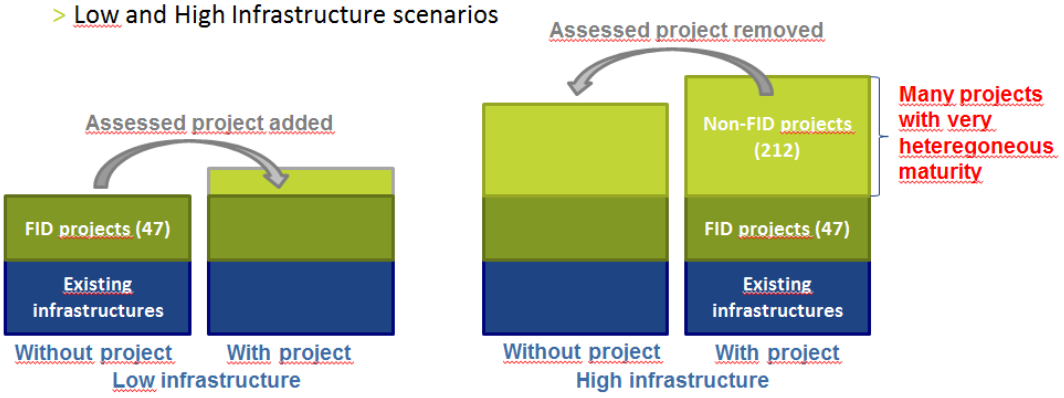
PS-CBAs are done under a wide range of scenarios

> Green or Grey Global context

> Price configurations

> Low and High Infrastructure scenarios

Political decision in Regional Groups to focus on some scenarios



Assessing mature projects against a more restrictive High Scenario would enhance information, while unmature projects could still be assessed on top of the High Scenario

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Thank You for Your Attention

Carmen Rodríguez Valdés
Adviser, System Development

ENTSOG -- European Network of Transmission System Operators for Gas
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Horizontal Directional Drillings with its own ATV (DIN 18324) Innovation for the Industry, Changes compared to ATV DIN 18319

The supplement 2015 of the VOB (German Construction Contract Procedures) complete edition 2012 was published on September 15, 2015. This supplement provides an independent ATV (General Technical Contract Conditions) for directional horizontal drillings for the first time.

Hitherto there was no such ATV for the directional horizontal drilling technique. The industry helped itself by using ATV DIN 18319 that was and is meant for pipe driving works. But in the VOB edition of 2009, however, directional horizontal drillings were explicitly excluded from these standards. Since then there was a gap in view of regulating the field of trenchless pipeline laying.

The fact that ATV DIN 18319 would be cut down by the field directional horizontal drillings was already known in October 2008 (annual congress at Chiemsee). At that time the DCA had tried to stop this process, but in vain. Henceforth the DCA has been pursuing the idea to install an independent ATV. Together with Rohrleitungsbauverband e.V., the Hauptverband der Deutschen Bauindustrie (main committee of the German construction industry) could be convinced that the directional horizontal drilling technique is a self-contained construction method that only has few in common with pipe driving. Finally in 2011, the Hauptverband der Deutschen Bauindustrie initiated the formulation of an independent ATV for directional horizontal drillings. A group of experts that were appointed by the Hauptausschuss Tiefbau (HAT) (main committee civil engineering underground) started work in August 2013; the comments-resolution meeting was concluded already in February 2015.

The area of application of ATV DIN 18324 includes the performance of directional drillings and the adjacent pull-in of pipelines. Not included are services like the production of ditches of any kind, drill work, removal of drill cuttings and the like. For such services other applicable ATVs have to be consulted.

A special part in the new standards particularly concentrates on soil explorations and soil description. This part is based on the classification of soil and rock layers in homogenous areas that is relevant for all underground standards. This parameter had to be complied with by the task group, of course. We managed, however, to define the required parameters and properties (subsoil parameters) especially for the directional horizontal drilling technique. These parameters can be gathered from the subsequent lecture.

Another important aspect of this ATV DIN 18324 now on hand deals with the accuracy, or rather with the tolerances during directional horizontal drillings. In this matter the new standards also differ considerably from DIN 18319.

The issue drilling fluids (configuration) is also granted specific consideration. Another important aspect, the disposal of drilling fluids, is regulated in chapter 4.1.7. The set of problems concerning the mixture of drilling fluids with additives is clearly regulated here.

Documentation of directional horizontal drillings was regulated as well. In section 3.5 some distinct statements concerning this issue are formulated. Here it is laid down which parameters have to be recorded.

The new ATV DIN 18324 addresses all aforementioned topics as standard benefit; beyond these there are of course “special services”.

These include for example calculational evidence of stability, preservation of evidence, noise and percussion measurement, resurvey of the pipelines, etc. Here we have to note loading, transport and disposal of the detached soil including bentonite suspension. These services have to be explicitly demanded and recompensed within the scope of work from the client!

Concluding an important special feature has to be mentioned:

Apart from the application of other public regulations, the ATV DIN 18324 requires that directional horizontal drilling procedures are performed in accordance with DCA’s Technical Guidelines. This is a milestone for our day-to-day projects. Now I hope that the new ATV will become a work recognised by all those involved as fast as possible; a transfer of the corresponding regulations also into the private sector was desirable.

Dipl.-Ing./EWE Hermann Lübbers
Deputy Chairman of the group of consulting engineers ATV DIN 18324
President of the “Drilling Contractors Association“

Horizontalspülbohrungen mit eigener ATV (DIN 18324)
Neuerungen für die Branche, Änderungen im Vergleich zur ATV DIN 18319

Am 15.09.2015 ist der Ergänzungsband 2015 zur VOB Gesamtausgabe 2012 erschienen. Erstmals gibt es mit Herausgabe dieses Ergänzungsbandes eine eigenständige ATV (Allgemeine Technische Vertragsbedingungen) für Horizontalspülbohrarbeiten.

Eine derartige ATV existierte für die Horizontalbohrtechnik bis dato nicht. Die Branche bediente sich hilfsweise der ATV DIN 18319, welche für Rohrvortriebsarbeiten galt und immer noch gilt. Mit der Ausgabe der VOB 2009 wurden Horizontalspülbohrungen aber explizit aus dieser Norm ausgeschlossen. Seit diesem Zeitpunkt existiert für diesen Bereich der grabenlosen Rohrverlegung eine Regelungslücke.

Die Tatsache, dass der Geltungsbereich der ATV DIN 18319 um den Bereich Horizontalspülbohren gekürzt werden sollte, wurde bereits im Oktober 2008 bekannt (Jahrestagung am Chiemsee). Der DCA versuchte seinerzeit diesen Prozess noch aufzuhalten, jedoch ohne Erfolg. Deshalb wurde fortan die Schiene einer „eigenständigen ATV“ verfolgt. Zusammen mit dem Rohrleitungsbauverband e.V. wurde der Hauptverband der Deutschen Bauindustrie davon überzeugt, dass es sich bei der Horizontalbohrtechnik um ein eigenständiges Bauverfahren handelt, welches nur wenige Gemeinsamkeiten mit dem Rohrvortrieb aufweist. Im Jahr 2011 brachte der Hauptverband der Deutschen Bauindustrie dann die Erarbeitung einer eigenständigen ATV für Horizontalspülbohrarbeiten auf den Weg. Im August 2013 nahm der vom Hauptausschuss Tiefbau (HAT) eingesetzte Expertenkreis seine Arbeit auf, bereits im Februar 2015 wurde die Einspruchslesung abgeschlossen.

Der Geltungsbereich der ATV DIN 18324 umfasst die Erstellung von gesteuerten Bohrungen mittels HDD-Technologie, sowie das anschließende Einziehen von Leitungen. Nicht erfasst sind die Leistungen wie die Herstellung von Baugruben jedweder Art, Bohrarbeiten, Ausbau von Bohrungen und dgl.. Für diese Tätigkeiten müssen entsprechende, dafür geltende ATV´s herangezogen werden.

Einen besonderen Teil nimmt in der neuen Norm die Baugrunderkundung und –beschreibung ein. Basis für diesen Abschnitt stellt die für alle Tiefbaunormen geltende Einstufung der Boden- und Felsschichten in Homogenbereiche dar. Diese Vorgabe war durch den Arbeitskreis selbstredend zu erfüllen. Es ist uns jedoch gelungen, die erforderlichen Kennwerte und Eigenschaften (Baugrundkenngrößen) speziell für die Horizontalbohrtechnik festzuschreiben. Die Kenngrößen sind dem folgenden Vortrag zu entnehmen.

Ein weiterer wichtiger Punkt in der nun vorliegenden ATV DIN 18324 befasst sich mit der Genauigkeit oder besser ausgedrückt mit den Toleranzen bei Horizontalspülbohrungen. Auch in diesem Punkt unterscheidet sich die neue Norm wesentlich von der DIN 18319.

Der Frage der Bohrspülung (Konfiguration) wird ebenfalls besonderer Raum geschenkt. Ein weiterer wichtiger Gesichtspunkt, die Bohrspülungsentsorgung ist im Kapitel 4.1.7 geregelt. Die Problematik der Vermischungen der Bohrspülungen mit Additiven ist hier eindeutig geregelt.
Auch die Dokumentation der Horizontalbohrarbeiten ist geregelt worden. Im Abschnitt 3.5 werden eindeutige Aussagen zu dieser Thematik getroffen. Die zu protokollierenden Parameter sind hier festgelegt.

Die neue ATV DIN 18324 spricht bei all den zuvor genannten Punkten von der sogenannten Regelleistung, daneben gibt es natürlich noch die „Besonderen Leistungen".
Hierzu zählen beispielsweise rechnerische Standsicherheitsnachweise, Beweissicherungen, Lärm- und Erschütterungsmessungen, Nachvermessungen der Leitungen etc.. Besonders zu erwähnen ist hier das Laden, Transportieren und Entsorgen des gelösten Bodens inklusive der Bentonitsuspension. Diese Leistung ist vom Auftraggeber explizit im Leistungsverzeichnis zu fordern und zu vergüten!

Eine wichtige Besonderheit zum Schluss:

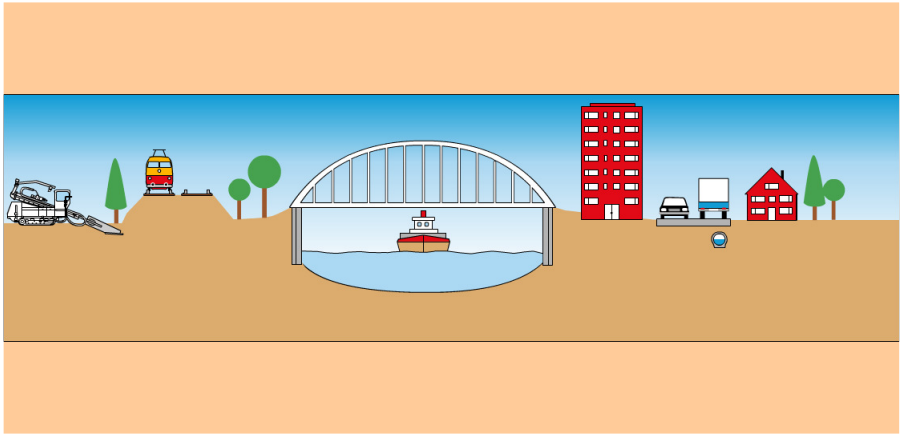
Die ATV DIN 18324 fordert neben der Anwendung anderer öffentlicher Regelwerke eine Ausführung der Horizontalbohrmaßnahme auf Basis der Technischen Richtlinien des DCA. Ein Meilenstein für unsere täglichen Projekte. Ich hoffe, die neue ATV wird schnellstmöglich zu einem von allen Beteiligten anerkannten Werk und wünsche mir eine Übertragung der entsprechenden Regelungen auch in die private Wirtschaft.

Dipl.-Ing./EWE Hermann Lübbers
Stellvertretender Obmann Fachberaterkreis ATV DIN 18324
Präsident „Verband Güteschutz Horizontalbohrungen e.V."

Technische Vertragsbedingungen in der Horizontalbohrtechnik

ATV DIN 18324

Dipl.-Ing./EWE Hermann Lübbers, öbuv Sachverständiger HDD



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Dipl.-Ing./EWE Hermann Lübbers HDD – Savoir – vivre – in network and pipeline construction Beermann Bohrtechnik GmbH

ATV DIN 18319 Rohrvortrieb

ATV DIN 18319 AA N 45

Datum: 2012 September

DIN 18319

VOB Vergabe- und Vertragsordnung für Bauleistungen — Teil C: Allgemeine Technische Vertragsbedingungen für Bauleistungen (ATV) — Rohrvortriebsarbeiten

Ersatz für DIN 18319:2010-04

Nur für die Gremienarbeit

Dokument-Typ: Norm
Dokument-Untertyp:
Dokumentstufe:
Dokumentsprache: D

STD Version 2.4e - RC2

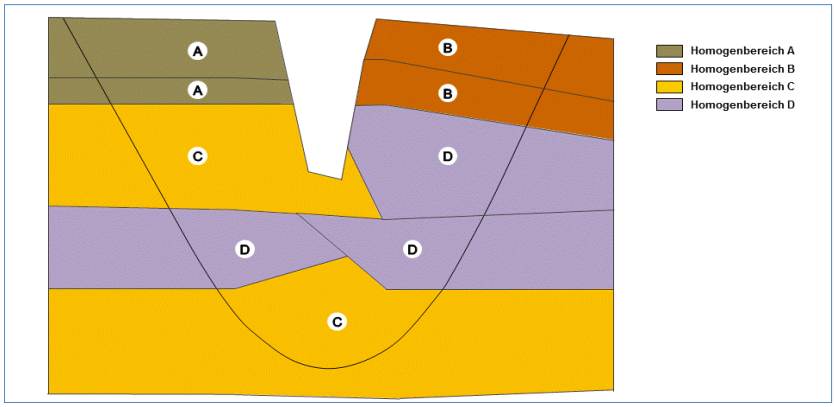
Horizontalspülbohren wurde 2009 aus dem Geltungsbereich herausgenommen!

Im Jahr 2011 brachte der Hauptverband der Deutschen Bauindustrie dann die Erarbeitung einer eigenständigen ATV für Horizontalspülbohrarbeiten auf den Weg.

Im August 2013 nahm der vom Hauptausschuss Tiefbau (HAT) eingesetzte Expertenkreis seine Arbeit auf, bereits im Februar 2015 wurde die Einspruchslesung abgeschlossen.

Technische Vertragsbedingungen in der Horizontalbohrtechnik ATV DIN 18324

Dipl.-Ing./EWE Hermann Lübbers
Stellvertretender Obmann Fachberaterkreis ATV DIN 18324



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Geltungsbereich

Abschnitt 1.1

Die ATV DIN 18324 „Horizontalspülbohrarbeiten“ gilt für gesteuerte Bohrungen zwischen einem Ein- und Austrittspunkt, bestehend aus einer Pilotbohrung und weiteren Aufweitungsbohrungen im Spülbohrverfahren mit anschließendem Einziehen von Leitungen, z.B. Rohre, Rohrbündel, Filter- oder Sickerrohre und Kabel beliebigen Profils.

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Geltungsbereich

Abschnitt 1.2

Die ATV 18324 gilt nicht für

das Herstellen von Start-, Ziel-, Zwischen-, Berge- oder sonstigen Baugruben,

Bohrarbeiten

Ausbau von Bohrungen

Entwässerungskanalarbeiten

Druckrohrleitungsarbeiten

Rohrvortriebsarbeiten

das Legen von Kabeln und Kabelschutzrohren in offener Bauweise

Bei Bedarf müssen die entsprechenden ATV zusätzlich herangezogen werden !

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Regelleistung

Die in den Abschnitten 2.4.1 Bohrspülung, 3 Ausführung und 4.1 Nebenleistungen aufgeführten Leistungen definieren die Regelleistung und damit das vom Auftragnehmer geschuldete Bausoll. Diese Leistungen sind auch ohne besondere Erwähnung im Leistungsverzeichnis zu erbringen, wenn die ATV DIN 18324 als Vertragsbestandteil vereinbart ist.

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Regelleistung

► Ausführung nach technischem Regelwerk: Technische Richtlinien der DCA; Arbeitsblatt DWA-A 125, Abschnitt 8,9 und 10; DVGW Arbeitsblatt GW 321; DB/BDEW Kreuzungsrichtlinien; (Abschnitt 3.1.1)

► Wahl des Verfahrens- und Bauablaufs, Einsatz der Bohrwerkzeuge und Baugeräte durch den Auftragnehmer (Abschnitt 3.1.2)

► Benennung des Verfahrens- und Bauablaufs, der Wahl und Anordnung der Bohrwerkzeuge sowie des Ortungssystems auf Verlangen des Auftraggebers

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Regelleistung

► Einhaltung der zulässigen Toleranzen: Richtungsabweichung max. 10% der max. Tiefenlage von der Leitungssollachse; Abweichung des Leitungsradius max. 10% vom Leitungssollradius (Abschnitt 3.2.1); Abweichung am Eintrittspunkt: einfacher Leitungsdurchmesser, max. 30 cm (Abschnitt 3.2.2); Abweichung am Ausrittspunkt : max. 2% der Bohrlänge, aber max. 5 m (Abschnitt 3.2.3)

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Regelleistung

- ▶ Bohrspülung konfigurieren (Abschnitt 4.1.5), liefern, anmischen und ggf. aufbereiten bis zu einer Grenzmenge vom 10-fachen des verdrängten Leitungsvolumens (Abschnitt 4.1.4)
- ▶ Prüfung der Eignung der Bohrspülung sowie deren Ausgangsprodukte; Nachweis auf Verlangen des Auftraggebers (Abschnitt 2.4.1)
- ▶ Transport der Bohrspülung von der Eintritts- bzw. Austrittsseite zur Wiederaufbereitungsanlage (Abschnitt 4.1.6)

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Regelleistung

- ▶ Sichtprüfung beigestellter Leitungen (Abschnitt 3.1.5)
- ▶ Einziehen der Leitungen unter Einhaltung der zulässigen Zugkräfte und Biegeradien (Abschnitt 3.4)
- ▶ Ballastieren beim Einzug (Abschnitt 3.4)

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Regelleistung

► Beobachtung der Baugrundverhältnisse während der Bohrung; bei abweichenden Feststellungen unverzügliche (ohne schuldhaftes Zögern) Information des Auftraggebers (Abschnitt 3.1.4)

► weitere Beobachtungen während der Bohrung: bei Änderungen der Beschaffenheit der Bohrspülung, Spülungsaustritten oder –verlusten, Bodenauftrieb, Absinken des Wasserspiegels oder der Bohrspülung etc. unverzügliche (ohne schuldhaftes Zögern) Information des Auftraggebers ; Abschnitt 3.1.6)

► Dokumentation (Abschnitt 3.5)

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Besondere Leistungen

Besondere Leistungen bedürfen der gesonderten Vereinbarung um Bestandteil des geschuldeten Bausolls zu werden. Voraussetzung ist die besondere Erwähnung im Leistungsverzeichnis sowie eine Vergütungsvereinbarung. Dies kann in Form einer vom Bieter zu verpreisenden Leistungsposition erfolgen. Eine besondere Leistung kann aber auch zum Bestandteil einer anderen Leistungsposition („Nebenleistung“) erklärt werden.
Typische Besondere Leistungen sind in Abschnitt 4.2 aufgezählt. Weitere Besondere Leistungen können während der Bauausführung erforderlich werden
(→ Anspruch auf zusätzliche Vergütung)

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Besondere Leistungen

- ► rechnerische Nachweise für die Standsicherheit , Ausführungszeichnungen (Abschnitt 4.2.2, 4.2.3)
- ► Beweissicherungen (Abschnitt 4.2.3)
- ► Spritzschutzeinrichtungen (Abschnitt 4.2.4)
- ► Umsetzen der Bohranlage und anderer Geräte, Umrüsten von Bohrwerkzeugen auf Anordnung des Auftraggebers
- ► Leistungen für Start- und Zielgruben (Abschnitt 4.2.6)

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Besondere Leistungen

- ► Lärm- und Erschütterungsmessungen, Dichtheitsprüfungen, Kaliberprüfungen, Korrosionsschutzmessungen, optische Inspektionen (Abschnitt 4.2.7)
- ► Nachvermessungen der Leitung, Lage- und Bestandspläne (Abschnitt 4.2.8)
- ► Verpressen oder Verfüllen von Ring- und Hohlräumen (Abschnitt 4.2.9)
- ► Laden, Transportieren und Entsorgen des gelösten Bodens und Fels inklusive der Bentonitsuspension (Abschnitt 4.2.10)

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Anspruch auf zusätzliche Vergütung

Grundsätze:

➔ erforderliche Leistungen zur Gefahrenabwehr („Gefahr in Verzug“) sind vom Auftragnehmer unverzüglich („ohne schuldhaftes Zögern“) zu erbringen (Abschnitt 3.1.7 und 3.3.2)

➔ der Auftragnehmer hat den Auftraggeber unverzüglich („ohne schuldhaftes Zögern“) über alle besonderen Vorkommnisse zu informieren (abweichende Baugrundverhältnisse, Verbrüche, Spülungsaustritte, Schäden an einzuziehenden Leitungen, ungeeignete Witterungsverhältnisse, Antreffen von Hindernissen oder Kampfmitteln, Festgehen oder Verlust von Bohrrohren, Bohrgestängen oder Bohrwerkzeugen; Abschnitte 3.1.4, 3.1.7, 3.1.8, 3.3.1, 3.3.3)

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Anspruch auf zusätzliche Vergütung

Grundsätze:

➔ die weiteren Leistungen sind von Auftraggeber und Auftragnehmer **gemeinsam** festzulegen

➔ Voraussetzung für einen Vergütungsanspruch ist, dass der Auftragnehmer die jeweilige Ursache nicht zu vertreten hat

➔ ansonsten gelten die Vorschriften des § 2 Nr. 2, 5 und 8 VOB/B zu geänderten und zusätzlichen Leistungen und des § 6 VOB/B zu Behinderungen

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Abschnitt 0: Aufstellen der Leistungsbeschreibung

§ 7 Abs. (1) Nr. 7. VOB/A :

„Die Hinweise zur Aufstellung der Leistungsbeschreibung“ in Abschnitt 0 der Allgemeinen Technischen Vertragsbedingungen für Bauleistungen, DIN 18299 ff., sind zu beachten.

§ 7 Abs. (1) Nr. 6. VOB/A :

Die für die Ausführung der Leistungen wesentlichen Verhältnisse der Baustelle, z.B. Boden- und Wasserverhältnisse, sind so zu beschreiben, dass der Bewerber ihre Auswirkungen auf die bauliche Anlage und die Bauausführung hinreichend beurteilen kann

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Abschnitt 2.1
Beschreibung des Baugrunds

Der Baugrund ist zu untersuchen, zu benennen und zu beschreiben

Abschnitt 2.2
Beschreibung und Einteilung von Boden und Fels in Homogenbereiche

Boden und Fels sind entsprechend ihrem Zustand vor dem Lösen in Homogen-Bereiche einzuteilen.
Der Homogenbereich ist ein begrenzter Bereich, bestehend aus einzelnen oder mehreren Boden- oder Felsschichten, der für Horizontalspülbohrarbeiten vergleichbare Eigenschaften aufweist.

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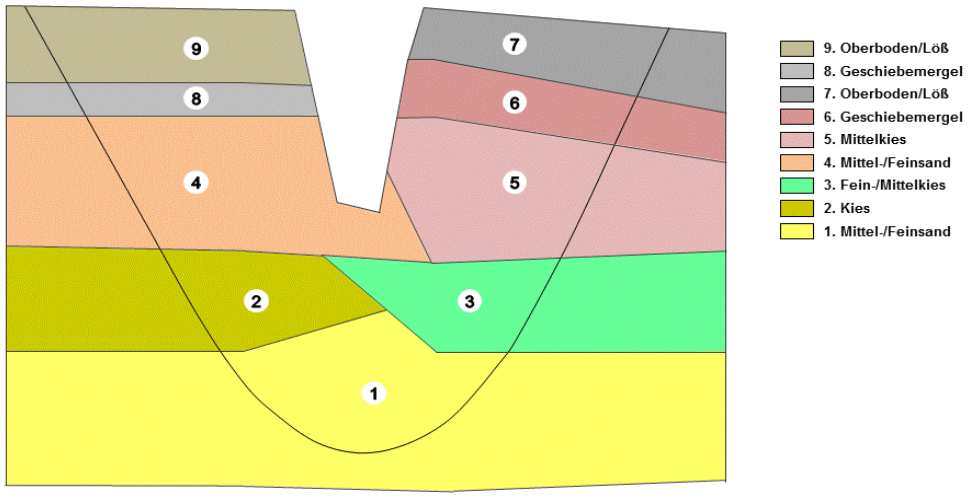
▶ Baugrunderkundung und –beschreibung gemäß VOB/C – ATV DIN 18324

Geotechnische Kenngrößen Boden
ortsübliche Bezeichnung
Korngrößenverteilung mit Körnungsbändern
Massenanteile Steine, Blöcke und große Blöcke
mineralogische Zusammensetzung der Steine, Blöcke und großen Blöcke
Dichte
undränierte Scherfestigkeit
Wassergehalt
Plastizitätszahl
Konsistenzzahl
Durchlässigkeit
Lagerungsdichte
Kalkgehalt
Sulfatgehalt
Organischer Anteil
Benennung und Beschreibung organischer Böden
Abrasivität

▶ Baugrunderkundung und –beschreibung gemäß VOB/C – ATV DIN 18324

Geotechnische Kenngrößen Fels
ortsübliche Bezeichnung
Benennung von Fels
Dichte
Verwitterung und Veränderungen, Veränderlichkeit
Kalkgehalt
Sulfatgehalt
Druckfestigkeit
Trennflächenrichtung, Trennflächenabstand, Gesteinskörperform
Gebirgsdurchlässigkeit
Abrasivität

▶ Baugrunderkundung und –beschreibung gemäß VOB/C – Praxisbeispiel



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▶ Baugrunderkundung und –beschreibung gemäß VOB/C – Praxisbeispiel

VOB 2012: ATV DIN 18300, 18301, 18319 etc.

VOB 2015 (?): alle Tiefbau ATV

Altes System mit Bodenklassen

Schicht	Klasse
Schicht 1	Klasse x und y
Schicht 2	Klasse x und z
Schicht 3	Klasse y

Klassen nach Homogenbereich

Schicht	Homogenbereich
Schicht 1	A
Schicht 2	
Schicht 3	C

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▶ Baugrunderkundung und –beschreibung gemäß VOB/C – Praxisbeispiel

Geotechnische Kenngrößen Boden
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Sulfatgehalt
Organischer Anteil
Benennung und Beschreibung organischer Böden
Abrasivität

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▶ Baugrunderkundung und –beschreibung gemäß VOB/C – Praxisbeispiel

Schicht	Korngrößenmassen-anteil ≤ 0,002 mm	Korngrößenmassen-anteil ≤ 0,063 mm	Korngrößenmassen-anteil ≤ 2 mm	Ungleichförmig-keitszahl U	Kurzzeichen DIN 18196
Schicht 1 Mittel-/Feinsand	0%	0% - 2%	98% -100%	6,2 – 7,4	SW
Schicht 2 Kies	0%	0%	3% - 5%	3,2 - 3,5	GE
Schicht 3 Fein-/Mittelkies	0%	0%	16% - 25%	4,7 – 5,0	GE
Schicht 4 Mittel-/Feinsand	0%	3% - 6%	89% - 96%	6,9 – 8,5	SW
Schicht 5 Mittelkies	0%	0%	11% - 19%	4,3 – 4,8	GE
Schicht 6 Geschiebemergel	17% - 21 %	41% - 45%	30% - 38%	-	TL
Schicht 7 Oberboden/Löß	14% - 20%	44% - 51%	36% - 42%	-	UL
Schicht 8 Geschiebemergel	5% - 11%	28% - 38%	62% - 72%	-	ST*
Schicht 9 Oberboden/Löß	4% - 9%	34% - 39%	61% - 66%	-	UL*

▶ Baugrunderkundung und –beschreibung gemäß VOB/C – Praxisbeispiel

Schicht	Kurzzeichen DIN 18196	Lagerungs-dichte I_d	Konsistenz-zahl I_c	Plastizitäts-zahl I_p	Wasser-gehalt w_L
Schicht 1 Mittel-/Feinsand	SW	68% - 83%		-	-
Schicht 2 Kies	GE	87% - 92%	-	-	-
Schicht 3 Fein-/Mittelkies	GE	66% - 79%	-	-	-
Schicht 4 Mittel-/Feinsand	SW	88% - 94%	-	-	-
Schicht 5 Mittelkies	GE	68% - 81%	-	-	-
Schicht 6 Geschiebemergel	TL	-	1,05 – 1,12	11% - 17%	31% - 34%
Schicht 7 Oberboden/Löß	UL	-	0,80 – 0,95	3% - 5%	23% - 28%
Schicht 8 Geschiebemergel	ST*	-	0,92 – 1,00	7% - 9%	15% - 24%
Schicht 9 Oberboden/Löß	SU*	-	1,03 – 1,11	2% - 4%	8% - 17%

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▶ Baugrunderkundung und –beschreibung gemäß VOB/C – Praxisbeispiel

Homogen-bereich	Schicht	Korngrößen-massenanteil ≤ 0,002 mm	Korngrößen-massenanteil ≤ 0,063 mm	Korngrößen-massenanteil ≤ 2 mm	Lagerungs-dichte I_d	Konsis-tenzzahl I_c	Plastizi-tätszahl I_p	Wasser-gehalt w_L
A	8, 9	4% - 11%	28% - 39%	61% - 72%		0,92 – 1,11	2% - 9%	8% - 24%
B	6, 7	14% - 21%	41% - 51%	30% - 42%		0,80 – 1,12	3% - 17%	23% - 34%
C	1, 4	0%	0% - 6%	89% - 100%	68% - 94%			
D	2, 3, 5	0%	0%	3% - 25%	66% - 92%			

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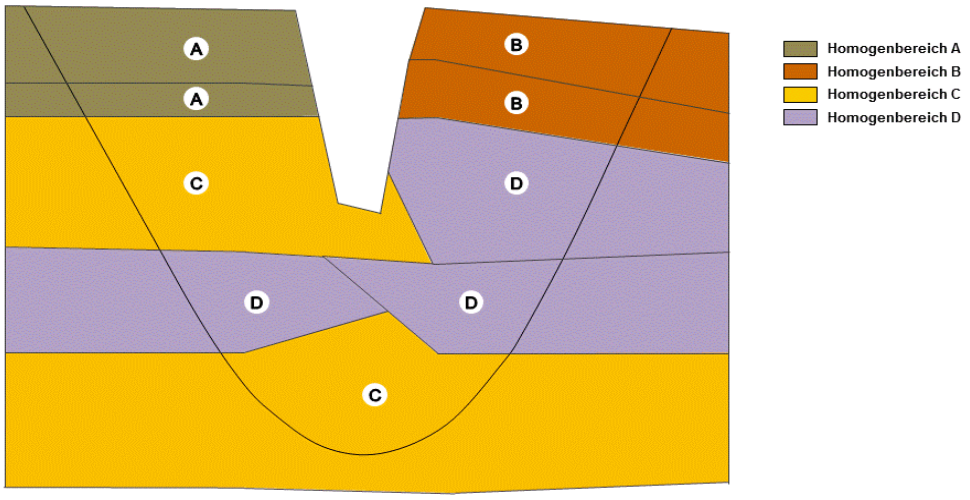
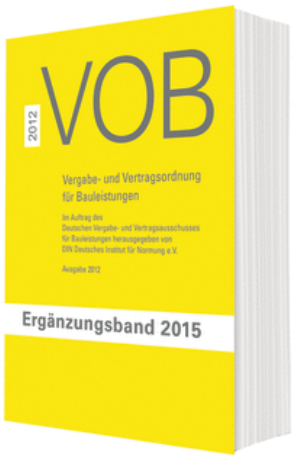
▶ Baugrunderkundung und –beschreibung gemäß VOB/C – Praxisbeispiel



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DCA Technical Guidelines 2015

Introduction of the Improvements, Explanations

Dipl.-Ing. (FH) Marc Schnau
Bohlen & Doyen GmbH

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DCA Task Group: **Compilation of DCA's publications – New Technical Guidelines**

Started in spring 2012 – Release of German version February 2015

Participants: P. Dick, H.-W. Hausmann, W. Ohm, D. Quante, U. Schröder, R. Stutzki, H. Lübbers, M. Schnau

Contract Conditions

Task Group Bending Radii

DCA Guidelines 2007

Quality Assurance

Task Group HDD and Soil

Developments / Updates / Lessons Learnt

Incorporation of results of Task Group „Subsoil/Geology“

Listing of the required investigations, their influence on HDD and the related guidelines and standards

2.2.6 Laboratory tests

The samples obtained in the site investigations will be laboratory tested.

Type and extent / coverage of the laboratory tests can be found in table 1 below.

Table 1: Type and extent/coverage of the laboratory tests

Laboratory analyses/ properties of soil layers (subsoil parameters)/ parameters	Recommendation	Impact on the horizontal drilling procedure	DIN Standards and regulations
Grain distribution	Extraction from all layers to be penetrated	bore hole stability, drilling fluid composition	DIN 18123 with grain size fraction curve
Grain roughness/abrasiveness	Extraction from all layers to be penetrated	Penetration speed, wearing of drill tools, bore hole stability	Abrasiveness coefficient LAK according to NF P18-579
Water permeability k [m/s] hydraulic conductivity kf (Transmissivity)	Extraction from all layers to be penetrated	Loss of drilling fluid	DIN 18130
Water content w [weighted %]	Extraction from all layers to be penetrated	Penetration speed	DIN 18121 - Soil, investigation and testing – water content

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Incorporation of results of Task Group „Subsoil/Geology“

Listing of the required investigations, their influence on HDD and the related guidelines and standards

Specific weight γ [kN/m³]	Extraction from all layers to be penetrated	Transport of cuttings	Density of wet soil and soil under buoyance according to DIN 18125-1 Soil, investigation and testing - Determination of density of soil
Laboratory analyses/ properties of soil layers (subsoil parameters)/ parameters	**Recommendation**	**Impact on the horizontal drilling procedure**	**DIN Standards and regulations**
Consistency Ic	Extraction from relevant layers to be penetrated	Bore hole stability	Consistency, plasticity index, consistency index, consistency limit according to DIN 18121
Friction angle φ [°]	Extraction from all layers to be penetrated	Bore hole stability, prevention of mud breakouts	Friction angle according to DIN 18137

Incorporation of results of Task Group „Subsoil/Geology“

Listing of the required investigations, their influence on HDD and the related guidelines and standards

Cohesion C' [kN/m2]	Extraction from all layers to be penetrated	Reduced effectiveness of the drill tools, by excess material sticking to the tools, drilling fluid, prevention of mud breakouts	Cohesion DIN 18137
Constrained modulus E_s or Young's modulus E or Pressure meter modulus E_m [kN/m²]	Extraction from all layers to be penetrated	Prevention of mud breakouts, penetration speed	DIN 18135
Shear strength Cu [kN/m²]	Extraction from all layers to be penetrated	Prevention of mud breakouts	DIN 18137
Pressure resistance UCS [N/mm², MPa]	For rock drillings: Extraction from all layers to be penetrated	drill tool selection, drilling speed	Unconfined pressure resistance of the rock in penetration direction according to DGGT-Recommendation No. 1 (German Society for Geoengineering). "Unconfined pressure tests on cylindrical rock samples" of the working group (AK) 3.3 "testing technology (in) rocks"
Joint structures [cm/dm]	In rocks	Penetration speed, bore hole strength	Geological structure, direction of joint structure and rock formations according to DIN EN ISO 14689-1
Ground water pH value /chloride/sulphates/ contaminations [mg/l]	Type and scope according to requirements	drilling fluid structure	BS 1377-3
Swelling characteristics of cohesive soil [vol. %]	Extraction from all layers to be penetrated	Reducing the effective diameter of the bore hole	Swelling characteristics of cohesive soils according to DIN 18132

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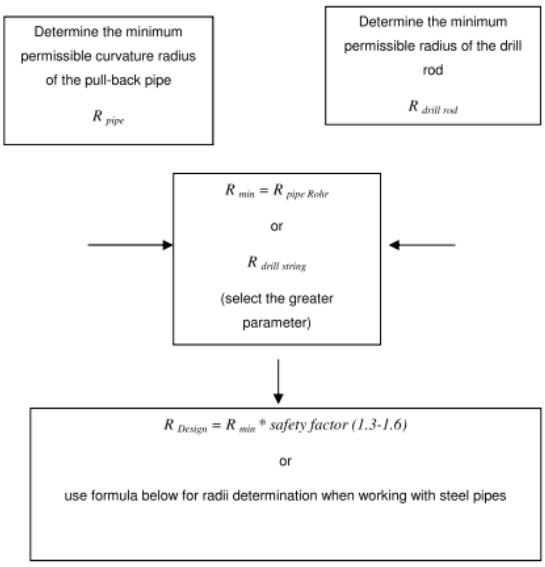
Detailing the determination of the design radius:

Whereas the previous edition only considered a design radius with a safety factor for steel pipelines, relating to the avoidance of coating damages, the new edition makes (more) clear that a safety factor is always recommended to both avoid damages and to ensure drillability.



HDD – Savoir – vivre – in network and pipeline construction

Detailing the determination of the design radius:

Additional information is given regarding bending radii of other materials than steel:

Table 3: Radius with regard to installation temperature

Installation temperature	≥ 0° C	≥ 10° ° C	≥ 20° C
Bending radius R_{min}	50*DA	35*DA	20*DA

For cast-iron pipes the bending radius depends on the angle in the sleeve joint

$$R_{\min} = \frac{L}{2 * \sin \alpha/2}$$

L = *length of pipe section* [m]

α = *angle* [degree]

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Tolerances for pilot drilling:

Although it is hardly possible to determine a universal value of allowable tolerances, this topic is addressed in the new edition

4.1.4 Tolerances

In general, the following tolerances apply for pilot drilling:

- Except for the entry and exit point, deviations from the planned drilling profile in every direction must not exceed 10% of the maximum lateral position and depth.
- Deviation of the actual bore hole radius from the intended design radius must not exceed 10%
- Deviations at the entry point may equal the pipe's diameter multiplied by factor one, but must not be greater than 0.3 m
- Deviations at the exit point may equal 2% of the drilling length but must not be greater than 5.0 m
- Assessing the tolerances should take into account the measurement and calculation accuracy of the applied navigation system and calculation method.

Methods for calculating the pull force

Insertion of an approximation equation to estimate required pulling forces:

$$F[kN] = L * D * f * \pi$$

F	= pulling force	[kN]
L	= drill length	[m]
D	= pipe diameter	[m]
f	= factor f	
π	= Pi = 3,14	

Table 4: Parameters for factor f:

Pipe material	**Factor:**	Flexible (e.g. PE)	to	Rigid (e.g. steel)
	f_M =	0.3		0.4
Drill radius	**Factor:**	Small	to	Large
	f_R =	0.5		0.3
Angular sum	**Factor:**	< 15°	to	> 30°
	f_W =	0.3		0.5
Obstacles in the drilling profile	**Factor:**	High probability	to	Low probability
	f_H =	0.5		0.3
Perfectly weighted pipe	**Factor:**	Yes	to	No
	f_b =	0.3		0.5
Soil friction characteristics	**Factor:**	Demanding	to	Standard
	f_B =	0.5		0.3

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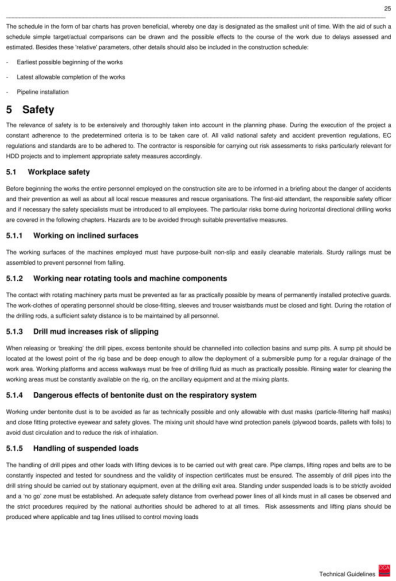
Safety

Incorporation of results of the task group „Safety Aspects in HDD“:



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The schedule in the form of bar charts has proven beneficial, whereby one day is designated as the smallest unit of time. With the aid of such a schedule simple target/actual comparisons can be drawn and the possible effects to the course of the work due to delays assessed and estimated. Besides these 'relative' parameters, other details should also be included in the construction schedule:

- Earliest possible beginning of the works
- Latest allowable completion of the works
- Pipeline installation

5 Safety

The relevance of safety is to be extensively and thoroughly taken into account in the planning phase. During the execution of the project a constant adherence to the predetermined criteria is to be taken care of. All valid national safety and accident prevention regulations, EC regulations and standards are to be adhered to. The contractor is responsible for carrying out risk assessments to risks particularly relevant for HDD projects and to implement appropriate safety measures accordingly.

5.1 Workplace safety

Before beginning the works the entire personnel employed on the construction site are to be informed in a briefing about the danger of accidents and their prevention as well as about all local rescue measures and rescue organisations. The first-aid attendant, the responsible safety officer and if necessary the safety specialists must be introduced to all employees. The particular risks borne during horizontal directional drilling works are covered in the following chapters. Hazards are to be avoided through suitable preventative measures.

5.1.1 Working on inclined surfaces

The working surfaces of the machines employed must have purpose-built non-slip and easily cleanable materials. Sturdy railings must be assembled to prevent personnel from falling.

5.1.2 Working near rotating tools and machine components

The contact with rotating machinery parts must be prevented as far as practically possible by means of permanently installed protective guards. The work-clothes of operating personnel should be close-fitting, sleeves and trouser waistbands must be closed and tight. During the rotation of the drilling rods, a sufficient safety distance is to be maintained by all personnel.

5.1.3 Drill mud increases risk of slipping

When releasing or 'breaking' the drill pipes, excess bentonite should be channelled into collection basins and sump pits. A sump pit should be located at the lowest point of the rig base and be deep enough to allow the deployment of a submersible pump for a regular drainage of the work area. Working platforms and access walkways must be free of drilling fluid as much as practically possible. Rinsing water for cleaning the working areas must be constantly available on the rig, on the ancillary equipment and at the mixing plants.

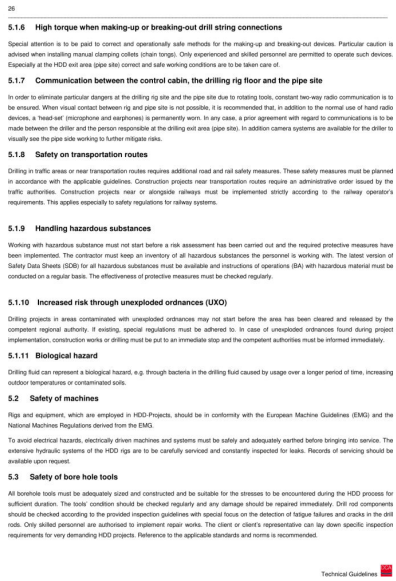
5.1.4 Dangerous effects of bentonite dust on the respiratory system

Working under bentonite dust is to be avoided as far as technically possible and only allowable with dust masks (particle-filtering half masks) and close fitting protective eyewear and safety gloves. The mixing unit should have wind protection panels (plywood boards, pallets with foils) to avoid dust circulation and to reduce the risk of inhalation.

5.1.5 Handling of suspended loads

The handling of drill pipes and other loads with lifting devices is to be carried out with great care. Pipe clamps, lifting ropes and belts are to be constantly inspected and tested for soundness and the validity of inspection certificates must be ensured. The assembly of drill pipes into the drill string should be carried out by stationary equipment, even at the drilling exit area. Standing under suspended loads is to be strictly avoided and a 'no go' zone must be established. An adequate safety distance from overhead power lines of all kinds must in all cases be observed and the strict procedures required by the national authorities should be adhered to at all times. Risk assessments and lifting plans should be produced where applicable and tag lines utilised to control moving loads

Technical Guidelines



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5.1.6 High torque when making-up or breaking-out drill string connections

Special attention is to be paid to correct and operationally safe methods for the making-up and breaking-out devices. Particular caution is advised when installing manual clamping collets (chain tongs). Only experienced and skilled personnel are permitted to operate such devices. Especially at the HDD exit area (pipe site) correct and safe working conditions are to be taken care of.

5.1.7 Communication between the control cabin, the drilling rig floor and the pipe site

In order to eliminate particular dangers at the drilling rig site and the pipe site due to rotating tools, constant two-way radio communication is to be ensured. When visual contact between rig and pipe site is not possible, it is recommended that, in addition to the normal use of hand radio devices, a 'head-set' (microphone and earphones) is permanently worn. In any case, a prior agreement with regard to communications is to be made between the driller and the person responsible at the drilling exit area (pipe site). In addition camera systems are available for the driller to visually see the pipe side working to further mitigate risks.

5.1.8 Safety on transportation routes

Drilling in traffic areas or near transportation routes requires additional road and rail safety measures. These safety measures must be planned in accordance with the applicable guidelines. Construction projects near transportation routes require an administrative order issued by the traffic authorities. Construction projects near or alongside railways must be implemented strictly according to the railway operator's requirements. This applies especially to safety regulations for railway systems.

5.1.9 Handling hazardous substances

Working with hazardous substance must not start before a risk assessment has been carried out and the required protective measures have been implemented. The contractor must keep an inventory of all hazardous substances the personnel is working with. The latest version of Safety Data Sheets (SDB) for all hazardous substances must be available and instructions of operations (BA) with hazardous material must be conducted on a regular basis. The effectiveness of protective measures must be checked regularly.

5.1.10 Increased risk through unexploded ordnances (UXO)

Drilling projects in areas contaminated with unexploded ordnances may not start before the area has been cleared and released by the competent regional authority. If existing, special regulations must be adhered to. In case of unexploded ordnances found during project implementation, construction works or drilling must be put to an immediate stop and the competent authorities must be informed immediately.

5.1.11 Biological hazard

Drilling fluid can represent a biological hazard, e.g. through bacteria in the drilling fluid caused by usage over a longer period of time, increasing outdoor temperatures or contaminated soils.

5.2 Safety of machines

Rigs and equipment, which are employed in HDD-Projects, should be in conformity with the European Machine Guidelines (EMG) and the National Machines Regulations derived from the EMG.

To avoid electrical hazards, electrically driven machines and systems must be safely and adequately earthed before bringing into service. The extensive hydraulic systems of the HDD rigs are to be carefully serviced and constantly inspected for leaks. Records of servicing should be available upon request.

5.3 Safety of bore hole tools

All borehole tools must be adequately sized and constructed and be suitable for the stresses to be encountered during the HDD process for sufficient duration. The tools' condition should be checked regularly and any damage should be repaired immediately. Drill rod components should be checked according to the provided inspection guidelines with special focus on the detection of fatigue failures and cracks in the drill rods. Only skilled personnel are authorised to implement repair works. The client or client's representative can lay down specific inspection requirements for very demanding HDD projects. Reference to the applicable standards and norms is recommended.

Technical Guidelines

HDD – Savoir – vivre – in network and pipeline construction

Environmental protection

Supplementation of this topic

6 Environmental protection

The horizontal directional drilling method causes less environmental harm than the open trench pipe or cable laying method. However, HDD-processes also impact the environment in various ways. Generally, the focus should be on minimising any environmental impact as far as possible. HDD is often used in areas where open trenching would be difficult and expensive to implement (wetlands, waters, mudflats, fens etc.) and which are environmentally sensitive in terms of nature conservation.
These areas in particular require high levels of environmental awareness for the implementation of HDD projects in such locations.
Precautionary measures could include:
- Soil protection
- Imission control
- Protection of species, habitats and woods

Implementation and effective management of all environmental recommendations into the HDD project is to be ensured. Together with occupational health and safety measures, appropriate response to environmental concerns could be supervised by an HSE-Manager (Health, Safety and Environmental Manager).

6.1 Material discharges, reduction and disposal

Material discharges into the environment have to be avoided and professional disposal of all waste materials is to be ensured. All used equipment and tools should therefore be in a clean and technically sound condition, CE-certified and undergo technical inspections regularly.
The following measures are recommended for working in sensitive/fragile natural spaces:

- Planned measures for emission control and waste disposal
- Establishing an action plan in case of an emergency
- Coordinating all plans and measures with the competent authorities

Bentonite, used for drilling fluid production, consists mainly of clay minerals and is therefore not considered as harmful to the environment. If the fluid consists additives to improve its physical and chemical characteristics, refer to the instructions on the Material Safety Data Sheets (MSDS).

Process the bentonite in a manner that avoids drifts of bentonite dust and install appropriate wind protection panels, if necessary.
Refer to the applicable Material Safety Data Sheets for handling the lubricants used when screwing the drill rods.
In general, any other emissions caused by HDD construction sites has to be minimised as far as possible by implementing the following measures:

- Regular inspection for leakage of machinery, devices, containers and hose connections on site and immediate repair of any found defects.
- Explore the possibility of reducing or exchanging environment-damaging products (e.g. hydraulic oils, lubricants, rust removers) with more environmentally friendly alternatives
- Avoid any material discharge into the ground during fuelling, oil and brake fluid exchange and other similar maintenance and repair works or implement those works off-site in a secured area.
- Take appropriate measures to prevent any uncontrolled material discharges in emission-sensitive areas
- Use noise protection and light shields, especially when working at night in urban or populated areas or when working in conditions which require specific measures for species protection.

Waste materials from the construction site must be professionally disposed and the disposal must be recorded. Provide sufficient work capacity for a clear-cut separation of construction site waste materials. Check re-usable substances (such as soil, mineral mixtures, water, drilling fluid etc.) for contamination and determine allowable recycling methods.

6.2 Soil protection

In order to avoid ground compaction of the topsoil, the topsoil layer must be excavated and stored separately according to European guidelines before the use of heavy machinery and equipment.
When soil conditions are sensitive the soil must be stabilised for the use of heavy machinery and equipment (e.g. with excavator mats, base layer made of mineral mix etc.), whereby blending of the mineral mix and the natural soil is to be avoided. Where required, install casing pipes in order to prevent mixing of the natural soil with the drilling fluid at the entry and exit point of the drilling.

Loosen the subsoil before filling of the topsoil.

6.3 Protection of species, habitats and woods

The following factors have to be taken into account for successful protection of species, habitats and woods on an HDD construction site.

- Comply with approved construction times, limit all construction works to the approved working and parking areas as well as access roads, especially in sensitive natural areas, fragile habitats or areas with protected species of animals and plants.
- Comply with wood protection requirements (Protection of trees, plantations and vegetation areas during construction work) and with the protective measures (Protection of trees, vegetation areas and animals during construction work).
- Coordinate further measures with the ecological site supervision, if on-site, or with the competent nature conversation authority. Communicate observations made on the ground to the competent authority.

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Project Execution

Incorporation of formulas to determine penetration rates / pump volumes

7.2.2.1 Rate of Penetration

The Rate of Penetration (ROP) has to be adapted to the pump volume, the drilling fluid characteristics and the cuttings. The drilling mud transports all the cuttings out of the borehole and the relationship between cutting/reaming the hole and generating new amounts of cuttings must be closely monitored. Washouts of the borehole must be avoided by optimising fluid and thereby cuttings circulation and transport through the borehole and back to the surface.

The solid content of the drilling fluid and the pump rate play a significant role for the drilling rate (Br).

$$B_r = \frac{V_{BL} * MF}{P_r} \left[\text{min}/m\right]$$

B_r	= drilling rate [min/m]	
V_{BL}	= bore hole volume per meter	[dm³/m]
MF	= mud factor (see 7.2.6.2.4)	[-]
P_r	= pump rate	[dm³/min]

$$V_{BL} = \frac{10 * \pi * d_A^2}{4} \left[dm^3/m\right]$$

V_{BL}	= bore hole volume per meter	[dm³/m]
d_A	= final bore hole diameter	[dm]

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Project Execution

Bouyancy calculation and tables with bouyancy forces of standard pipes

The (positive) buoyancy force is calculated according to the following formula:

$$F = \rho * V * g$$

ρ	= drilling fluid density	$[kg/m^3]$
V	= displaced pipe volume	$[m^3]$
g	= gravity = 9.81	$[m/sec^2]$

Table 9: Positive buoyancy force in the drilling fluid ((ρ = 1.05 – 1.2 kg/m³) for PE-pipes

Outer pipe diameter [mm]	Wall thickness [mm]	Mass [kg/m]	Buoyancy force [kN/m] [kN/m] ρ = 1.05 – 1.20 [kg/m³]	Resulting buoyancy force [kN/m] ρ = 1.05 – 1.20 [kg/m³]
110	10	3.02	0.10 – 0.11	0.07 - 0.08
200	18.2	9.98	0.32 – 0.37	0.23 – 0.27
315	28.6	24.7	0.80 – 0.92	0.56 – 0.68
400	36.3	39.82	1.29 – 1.48	0.90 – 1.09
500	45.4	62.25	2.02 – 2.31	1.41 – 1.70
630	57.2	98.81	3.21 – 3.67	2.24 – 2.70

Table 10: Buoyancy forces in the drilling fluid ((ρ = 1.05 – 1.2 kg/m³) for steel pipes

Outer pipe diameter [mm]	Wall thickness [mm]	Mass [kg/m] *	Positive buoyance [kN/m] ρ = 1.05 – 1.20 [kg/m³]	Resulting positive buoyance [kN/m] ρ = 1.05 – 1.20 [kg/m³]
114.3	6.30	16.80	0.11 – 0.12	-0.06 - -0.04
168.3	8.00	31.67	0.23 – 0.26	-0.08 – -0.05
273	8.80	57.41	0.60 – 0.69	0.04 – 0.13
323.9	10.0	77.51	0.85 – 0.97	0.09 – 0.21
457	11.0	121.14	1.69 – 1.93	0.50 – 0.74
610	14.2	208.91	3.01 – 3.44	0.96 – 1.39
711	16.0	274.59	4.09 – 4.67	1.40 – 1.98
914	20.0	441.51	6.76 – 7.72	2.43 – 3.39
1422	25.0	862.40	16.36 – 18.70	7.90 – 10.24

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Quality Assurance

Incorporation of the guideline „Quality Management“

Requirements regarding client‘s and designer‘s qualification

10.3 Client’s Qualification

The client should possess the relevant knowledge and expertise for the successful planning and implementation of HDD-projects. Planning should be executed according to the specifications explained in chapter 4 (project planning). If the project planning is not done by the client himself, a suitably qualified engineer has to be involved.

10.4 Technical Designer’s Qualification

The technical designer must have the relevant expertise and experience for planning HDD-projects according to the state of the art and fulfilling all quality and safety requirements. The technical designer supports the client during the implementation of all project phases. As for planning executed by the client, planning by a technical designer should be executed according to the specifications explained in chapter 4.

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Quality Assurance

Incorporation of the guideline „Quality Management“

Categorisation of an HDD project

Table 11: Criteria for categorising an HDD-project

Criteria HDD-project category	Category 1 (K1) Routine	Category 3 (K3) Complex
Drill length	Short, ≤ 150 m	Long, ≥ 500 m
Bore hole diameter	Small, ≤ 200 mm	Large, ≥ 500 mm
Distance to existing infrastructure	Distance > 30 m	Distance ≤ 5 m
Difference in altitude between entry and exit point	not relevant	≥ 10 m
Cover depth	Allowable minimum	Approximating allowable minimum
Static drilling fluid pressure	Allowable minimum	Approximating allowable minimum
Soil type	Fine-grained soils e.g. silty soild, fine sand	Coarse-grained soils or rock e.g. unconsolidated soils ≥ 40 % gravel/blocks alternating bedding of hard and soft soil layers/rock formations
Bedding conditions	Homogenous and fault-free	Heterogeneous, faulty, fissured, e.g. during injections

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Quality Assurance

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Categorisation of an HDD project

Criteria HDD-project category	Category 1 (K1) Routine	Category 3 (K3) Complex
Permeability	≤ 5 x 10 - 4 m/s	≥ 5 x 10 - 3 m/s
Chemical composition of the ground water	Fresh water	Sea water
Fragility of existing infrastructure in terms of subsidence and mud breakouts	Non-existing	High
Drilling radius	At least equal to the minimum bending radius multiplied by factor 3	Approximating the minimum bending radius
Authorisation procedure or conditions and requirements with regard to the obstacle to be crossed	Simple authorisation procedure, no adjustments of the standard execution procedure required	Complex authorisation procedure, comprehensive conditions and requirements resulting from the authorisation procedure must be fulfilled during project execution

(All HDD-projects which do not fit category 1 or 3 are categorised 2 by default)

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Quality Assurance

Incorporation of the guideline „Quality Management“

Requirements and responsibilities

In order to ensure a qualified approach to planning and execution of each HDD-project, this guideline differentiates between three degrees of complexity for HDD projects:

- Category 1 Routine HDD-projects
- Category 2 Standard HDD- projects
- Category 3 Complex HDD- projects

Area of responsibility	Characteristics	K 1	K 2	K 3
Client	Characteristics of the culver and the pipe laying	x	x	x
Client	Pipe stresses (pressure, pulling forces, bending)	x	x	x
Client	Specifying the coordinate system (X,Y)	x	x	x
Client	Specifying of the necessary altitude indication	x	x	x
Client	Description of access conditions	x	x	x
Client/contractor	Scope of needed permits and authorisations, specific regulations applying to the obstacle to be crossed (e.g. railway crossing), carrying out authorisation procedure	x	x	x
Client	Laying out the disposal procedure for cuttings and drilling fluid	x	x	x
Client	Distance to neighbouring buildings, underground infrastructure (cables, foundations, slurry walls etc.)	x	x	x
Client/contractor	Indicating existing pipes (cable, pipelines etc.)	x	x	x
Contractor	Illustrating the overbend		x	x
Contractor	Parameters pilot drilling		x	x
Contractor	Information on the location system used	x	x	x
Contractor	As built and project documentation Bestandsvermessung und Dokumentation des Projektes		x	x

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Quality Assurance

Incorporation of the guideline „Quality Management“

Scope of investigations in relation to categories

10.5.3 Scope of the necessary subsoil analyses

Table 13 and 14 below contain the necessary scope of subsoil analysis depending on the categories defined above. Table 15 and 16 list specific QA-requirements for working in coarse-grained unconsolidated formations and the investigation scope for works in consolidated formations/rocks for category 3 HDD-projects.

Table 13: Scope of subsoil analyses (general)

Section	Content	K 1	K 2	K 3
Information on location	Describing the topographic and hydrographic conditions	x	x	x
	Location's history	x	x	x
	Data on water level fluctuations	x	x	x
	Data on river beds, scouring, currents	x	x	x
	Climate data	x	x	x
Section	**Content**	**K 1**	**K 2**	**K 3**
Subsoil investigation	Geotechnical drilling		x	x
	(Pressure) penetration test		x	x

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	Extracting samples of subsoil and rock		x	x
	Measuring the ground water level		x	x
	Measuring pore water pressure		x	x
	Information on abrasive characteristics			
laboratory analyses	Soil classification		x	x
	Rock classification			x
	Information on strength characteristics		x	x
	Geochemical information		x	x
	Describing the geo-hydraulic conditions		x	x
Geophysical analysis	Evidence for sequence of subsoil layers, evidence for formation faults, detection of obstacles through electrical resistance, seismic, hydro-acoustic, electromagnetic measurements			x
Geotechnical report	Information on soil and rock classifications	x	x	x
	Assessing the drillability	x	x	x

Technical Guidelines

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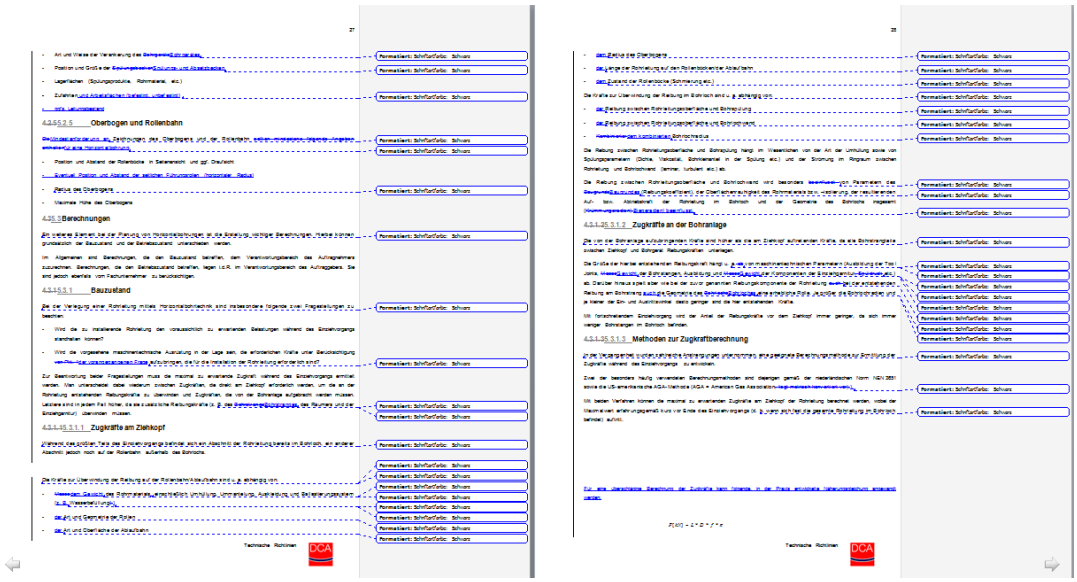
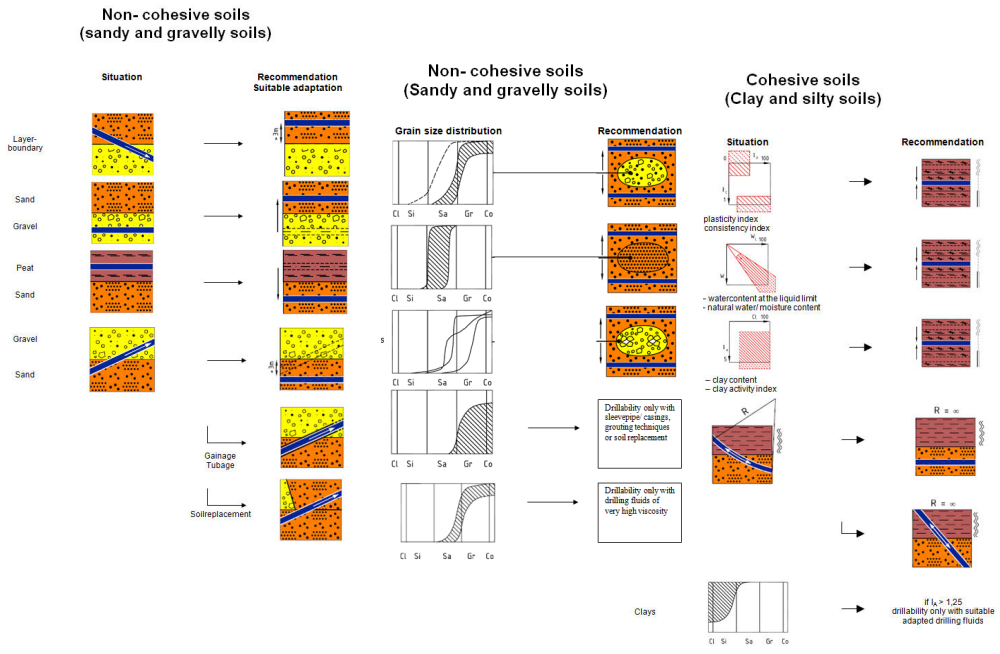
Textual / editorial modifications and amendments

Specification of requirements, Adjustments related to new developments, rephrasings for more clarity and more binding character (e.g. partial deletion of „should‘s and could‘s“)



Attachments

Recommendations of suitable adaptions related to geological conditions



Attachments

Quoted standards und useful standards

Quoted Standards

- BS 1377-3 1990 Methods of test for soils for civil engineering purposes. Chemical and electro-chemical tests
- DIN 1054 Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1
- DIN 4020 Geotechnical investigations for civil engineering purposes - Supplementary rules to DIN EN 1997-2
- DIN EN ISO 17892-1 Geotechnical investigation and testing - Laboratory testing of soil - Part 1: Determination of water content
- DIN 18121-2 Soil, investigation and testing – Watercontent
- DIN 18122-1 Soil, investigation and testing - Consistency limits - Part 1: Determination of liquid limit and plastic limit
- DIN 18122-2 Soil - investigation and testing - Part 2: Determination of the shrinkage limit
- DIN 18123 Soil, investigation and testing - Determination of grain-size distribution
- DIN 18125-1 Soil, investigation and testing - Determination of density of soil - Part 1: Laboratory tests
- DIN EN ISO 17892-2 Geotechnical investigation and testing - Laboratory testing of soil - Part 2: Determination of bulk density
- DIN 18130-1 Soil - investigation and testing; Determination of the coefficient of water permeability - Part 1: Laboratory tests
- DIN 18130-2 Soil, investigation and testing - Determination of the coefficient of water permeability - Part 2: Field tests
- DIN 18132 Soil, testing procedures and testing equipment - Determination of water absorption
- DIN 18135 Soil - Investigation and testing - Oedometer consolidation test
- DIN 18137-1 Soil, investigation and testing - Determination of shear strenght - Part 1: Concepts and general testing conditions
- DIN 18137-2 Soil, investigation and testing - Determination of shear strength - Part 2: Triaxial test
- DIN 18915 Vegetation technology in landscaping - Soil working
- DIN 18920 Vegetation technology in landscaping - Protection of trees, plantations and vegetation areas during construction work
- DIN 19731 Soil quality - Utilization of soil material
- DIN EN 545 Ductile iron pipes, fittings, accessories and their joints for water pipelines - Requirements and test methods
- DIN EN 598 Ductile iron pipes, fittings, accessories and their joints for sewerage applications - Requirements and test methods
- DIN EN 1997-1 Eurocode 7: Geotechnical design - Part 1: General rules
- DIN EN 1997-1/NA National Annex - Nationally determined parameters - Eurocode 7: Geotechnical design - Part 1: General rules
- DIN EN 1997-2 Eurocode 7: Geotechnical design - Part 2: Ground investigation and testing
- DIN EN 1997-2/NA National Annex - Nationally determined parameters - Eurocode 7: Geotechnical design - Part 2: Ground investigation and testing

Useful Standards for HDD

- DIN 4094-2 Subsoil - Field testing - Part 2: Borehole dynamic probing
- DIN 18128 Soil - Investigation and testing - Determination of ignition loss
- DIN 18196 Earthworks and foundations - Soil classification for civil engineering purposes
- DIN EN 1097-6 Tests for mechanical and physical properties of aggregates - Part 6: Determination of particle density and water absorption
- DIN EN ISO 14688-1 Geotechnical investigation and testing - Identification and classification of soil - Part 1: Identification and description
- DIN EN ISO 14688-2 Geotechnical investigation and testing - Identification and classification of soil - Part 2: Principles for a classification (ISO 14688-2:2004 + Amd 1:2013)
- DIN EN ISO 22476-1 Geotechnical investigation and testing - Field testing - Part 1: Electrical cone and piezocone penetration test (ISO 22476-1:2012 + Cor. 1:2013)
- DIN EN ISO 22476-2 Geotechnical investigation and testing - Field testing - Part 2: Dynamic probing (ISO 22476-2:2005 + Amd 1:2011)
- NF P94-430-1 Rock - Determination of the rock abrasiveness - Part 1 : scratching-test with a pointed tool.

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Questions?

HDD – Savoir – vivre – in network and pipeline construction

Thank you very much for your attention!

Drilling mud recycling
Presented by CLAMENS

1. Regulatory environnement
   a. Kind of waste
   b. Transport
   c. Disposing of waste
2. Our process
3. The sand and gravel
4. Environnental foot print

1.a. Kind of waste

1.a. Registered waste : Each type of waste gets registered by a number in classified industries

– In case of drilling mud :

Number	Waste
01 05 04	Drilling mud with fresh water.
01 05 05*	Drilling mud with oil
01 05 06*	Drilling mud with hazardous substances
01 05 07	Drilling mud with barium salt
01 05 08	Drilling mud with chlorides

1.b. Transport

- Transport licence is required to transport waste.

Example of licence : N° 77 DDT – 13/065

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RÉPUBLIQUE FRANÇAISE
PRÉFET DE SEINE-et-MARNE

Direction départementale des territoires de Seine-et-Marne

Service Education et Sécurité Routière
Unité Réseau et Circulation

Récépissé de déclaration n° 77 DDT – 13/065
Délivré à la SA CLAMENS pour l'exercice de l'activité de transport par route de déchets dangereux et non dangereux.

La préfète de Seine-et-Marne
Officier de la Légion d'honneur
Officier de l'Ordre national du Mérite

VU le code de l'environnement et notamment sa partie réglementaire, livre V, titre IV,

VU la loi n° 75-633 du 15 juillet 1975 modifiée relative à l'élimination des déchets et à la récupération des matériaux,

VU le décret n° 2007-1467 du 12 octobre 2007 relatif au livre V de la partie réglementaire du code de l'environnement et modifiant certaines autres dispositions de ce code,

DELIVRE à la SA CLAMENS dont le siège social est situé ZI SUD BP 209 – 77272 VILLEPARISIS cédex,

RECEPISSE de sa déclaration du 16 octobre 2013 relative à son activité de transport par route de déchets dangereux et non dangereux,

RECEPISSE n° 77 DDT – 13/065 délivré le 22 octobre 2013 à la direction départementale des territoires de Seine et Marne, pour 60 véhicules affectés au transport de déchets.

Une copie de ce récépissé doit être conservée à bord de chaque véhicule et doit être présentée à toute réquisition des agents chargés du contrôle en application de l'article R 541-53 du code de l'environnement.

La validité de ce récépissé est de 5 ans.

Melun, le 22 octobre 2013.
Pour la Préfète,
Pour le directeur départemental des territoires,
Le chef de l'Unité Sécurité et Circulation,

DESTINATAIRES :
- le Déclarant
- le Maire de VILLEPARISIS
- le Directeur Départemental du Service d'Incendie et de Secours
- le Chef de l'unité territoriale de la Direction Régionale et Interdépartementale de l'Environnement et de l'Energie (DRIEE), à Savigny-le-Temple
- Dossier

Communauté Économique Européenne

F

Ministère chargé des Transports

Licence n°

ILE DE FRANCE

CLAMENS
ZI SUD
RUE DES CARRIERES
77270 VILLEPARISIS

EN CAS DE CHANGEMENT D'ADRESSE EN ILE-DE-FRANCE
LE TITRE RESTE VALABLE

PARIS (FRANCE)

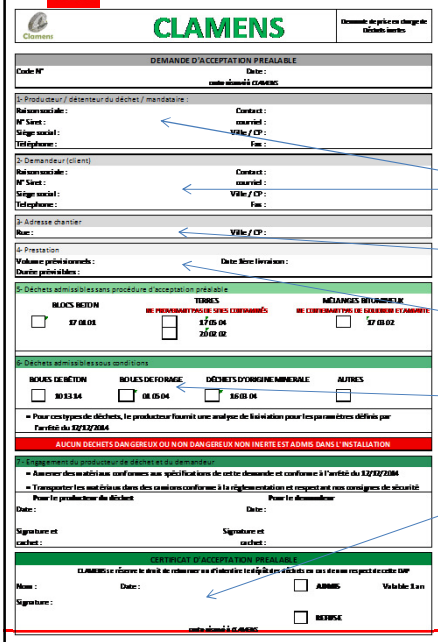
1.b. Disposing of waste

All industries need an « authorization » from State to be allowed to take care of waste, especially in case of muds

CHAPITRE 1.2 NATURE DES INSTALLATIONS

ARTICLE 1.2.1. LISTE DES INSTALLATIONS CONCERNEES PAR UNE RUBRIQUE DE LA NOMENCLATURE DES INSTALLATIONS CLASSEES

Rubrique	Alinéa	AS,A , D,NC	Libellé de la rubrique (activité)	Critère de classement	Seuil du critère	Unité du critère	Volume autorisé	Unités du volume autorisé	Détail des installations
2515	1	A	Broyage, concassage, criblage, ensachage, pulvérisation, nettoyage, tamisage, mélange de pierres, cailloux, minerais et autres produits minéraux naturels ou artificiels.	Puissance totale	>200	kW	1600	kW	Installations de recyclage de bétons de démolition, de boues de béton issue de centrales à béton et de déchets du BTP
2517	a	A	Station de transit de produits minéraux solides, à l'exclusion de ceux visés par d'autres rubriques,	capacité de stockage	75 000	m^3	200 000	m^3	Stockage des bétons concassés, cailloux, sables issus du recyclage
167	a	A	Stations de transit de déchets industriels provenant d'installations classées	-	-	-	-	-	Station de transit de mâchefer (V), la quantité maximale stockée est de : 60 000 tonnes



CLAMENS

DEMANDE D'ACCEPTATION PREALABLE

1- Producteur / détenteur du déchet / mandataire :

2- Demandeur (client)

3- Adresse chantier

4- Prestation

5- Déchets admissibles sans procédure d'acceptation préalable

6- Déchets admissibles sous conditions

ROUES DE BÉTON | ROUES DE FORAGE | DÉCHETS D'ORIGINE MINERALE | AUTRES

AUCUN DECHETS DANGEREUX OU NON DANGEREUX NON INERTE EST ADMIS DANS L'INSTALLATION

7- Engagement du producteur de déchet et du demandeur

CERTIFICAT D'ACCEPTATION PREALABLE

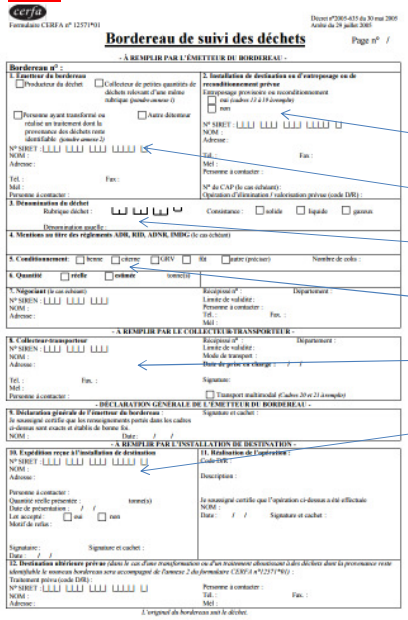
DAP

« Request of preliminary acceptance »

Information required :

- Waste producer
- Drilling site
- Quantity & duration
- Registration number of the waste
- Acceptance

+ Provide a Leaching analysis



Bordereau de suivi des déchets

- À REMPLIR PAR L'ÉMETTEUR DU BORDEREAU -

- À REMPLIR PAR LE COLLECTEUR-TRANSPORTEUR -

- DÉCLARATION GÉNÉRALE DE L'ÉMETTEUR DU BORDEREAU -

- À REMPLIR PAR L'INSTALLATION DE DESTINATION -

BSD

« Waste tracking slip »

Information required :

- Waste disposal
- Waste producer
- Registration number of waste
- Quantity & duration
- Waste road haulier
- Waste disposal

The rules for waste removal

1. Waste identification
   - ➢ Leaching analysis of mud
2. Identify a company allowed to take this waste
   - ✓ Check the State authorization
3. Identify a compagnie allowed to transport
   - ✓ Check his licence
4. Send a DAP to the company before drilling
   - ➢ Quantity – N°of waste – Duration
5. Send a BSD
   - ➢ Send a BSD with each truck

Our example

CLAMENS company

On drilling site

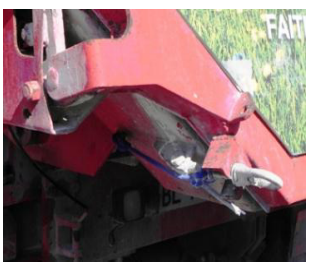
Storage tank :

- Pool double skin of 30 m3
- Pool double sking of 68 m3

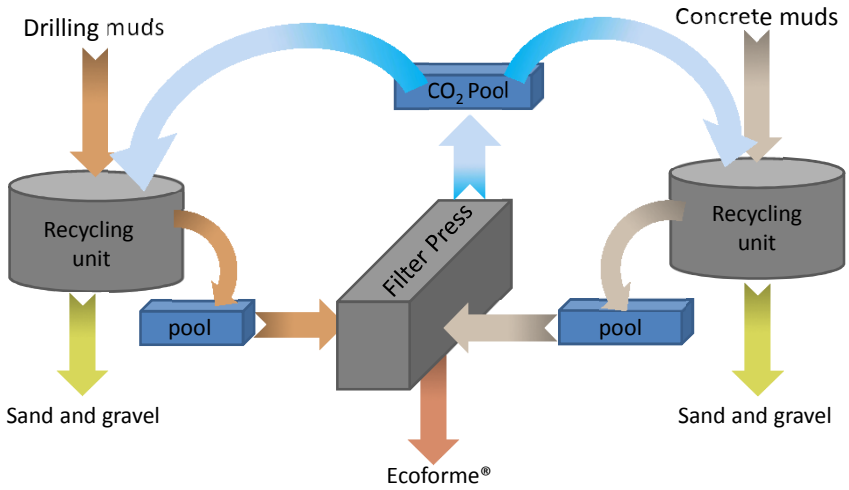
Pump :

- 3 Pump SELWOOD
- 1 pump BBA

Muds tansport



Process



Process

Recycled materials

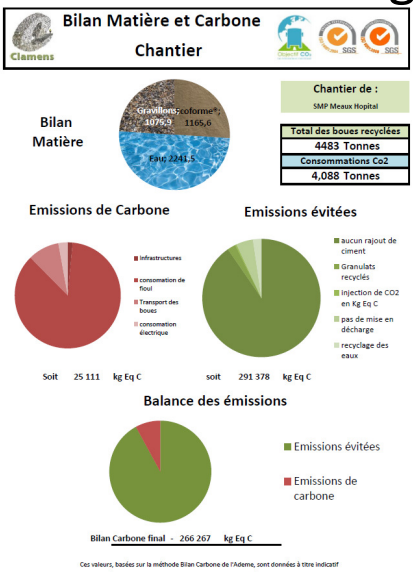
Gravel

Gravel

Sand

Ecoforme ®

Ecological foot print



Clamens S.M.P

- **4500 Tons of recycled mud** on MEAUX HOSPITAL
- **1075** Tons of recycled materials
- **1165** Tons of ECOFORME
- **4 Tons** of Co2 Consumed
  - ➢ Negative Carbon balance

Full face Hole opening- A new drilling tool increases the performance of HDD in hard rock

It is well known that conventional hard rock hole opening in HDD has a significant impact on costs in HDD operations and of course includes some medium to high risks especially when it comes to larger boreholes(>36”) where multiple reaming passes are required.

The newly developed hole opening equipment has a strong focus on solving and reducing the existing technical risk´s and problems to a minimum level. Furthermore one of the main reasons for the development of the tool was the enormous costs involved in hard rock drilling with HDD where time consuming reaming passes reduce the overall performance.

The new technology is based on the progress that had been made in drill pipes, drill rigs, mud handling equipment and drilling fluids over the recent years by utilizing the higher capacities and capabilities.

One of the key factors for reducing costs is the reduction of mechanical parts involved in the excavation process combined with stronger, more durable and exchangeable parts. Helpful for the development was also the experiences gathered in different applications like hard rock tunneling, Raise Boring within Herrenknecht.

This presentation discusses operational parameters like the ROP (rate of penetration), cutting size, cutting transport and of course the project related cutter choice for the hole opener system according the given project geology.

The biggest challenge in increasing the performance in rock drilling is seen in the cutting size and their transport from the tool face to surface. Herrenknecht therefore is focusing on a solution which also covers the cutting transport.

It is well known that HDD uses the borehole as discharge line to remove the cuttings out of the borehole. It is also well known that a slow velocity of the mud is not productive when transporting large cuttings as they tend to settle along the borehole. The slower the mud return flow the smaller the cuttings the fluid can carry (at consistent rheological properties) resulting in a lower overall progress.

Therefore, the major challenge is to find a way to transport the cuttings from the bit or reamer through a long horizontal section by using the borehole as a pressure line towards the exit. Up to now only solutions for the fluids and the fluid handling equipment has been developed to mitigate the limitations.

HDD - savoir-vivre - in network and pipeline construction

The existing problems with remaining cuttings left in the hole lead to large overcut dimensions to avoid pipes getting stuck during pullback. Excessive pumping of mud can lead to frac-outs when the fluid pressure is greater than the maximum allowable borehole pressure. Furthermore, the complexity of the mud design is increasing and results in costly mud monitoring and adjustment on jobsites.

This presentation discusses a solution which solves the related cutting transport problems and at the same time allows larger cutting particles sizes to be transported. This finally ends up in a new tooling series in conjunction with an innovative downhole jet-pump system which is able to drill and cut faster at lower cost and risks.

Vollschnittbohrlochaufweitung- Ein neues Bohrwerkzeug erweitert die Leistung von HDD in Hartgestein

Es ist weitgehend bekannt, dass Bohren in Fels im HDD Bereich einen signifikanten Einfluss auf die Kosten und Risiken hat, insbesondere bei größeren Durchmessern (>36“), bei denen bisher mehrfache Aufweitungsschritte erforderlich waren.

Der Fokus bei dem neuentwickelten HDD Bohrwerkzeug ist, die bestehenden technischen Risiken und Probleme zu lösen und auf ein Minimum zu reduzieren. Einer der Hauptgründe für die Entwicklung dieses Werkzeugs waren darüber hinaus die enormen Kosten, die bei Felsbohrungen im HDD durch die zeitraubenden Aufweitungsschritte entstehen und die Gesamtleistung beeinträchtigen.

Die neue Technologie basiert auf den Weiterentwicklungen der letzten Jahre, die bei den Bohrstangen und Bohranlagen erzielt wurden.

Einer der Schlüsselfaktoren bei der Kostensenkung im Felsbohren ist die Reduzierung der mechanischen Teile, die im Vortriebsprozess involviert sind sowie stärkere, langlebigere und austauschbare Teile. Bei der Entwicklung waren auch die Erfahrungen, die in verschiedenen Anwendungen wie Hartgesteinsvortrieb und dem Raise Boring bei Herrenknecht gesammelt wurden, hilfreich.

Diese Präsentation behandelt Parameter die die Penetrationsrate beeinflussen wie zum Beispiel, Bohrkleinabmessungen, Bohrkleintransport und selbstverständlich die projektbezogene und von der Geologie des Projektes abhängige Schneidrollenauswahl.

Die größte Herausforderung bei der Leistungsoptimierung im Hartgesteinsvortrieb wurde in der Bohrkleingröße und in dem Transport des Bohrkleins von der Ortsbrust bis zur Erdoberfläche gesehen. Für die Lösung eines optimierten Werkzeugs musst also auch eine Lösung für den Abtransport des maximierten Bohrkleins entwickelt werden.

Bekanntermaßen wird im HDD das Bohrloch als Förderleitung genutzt, um das Bohrklein aus dem Bohrloch zu befördern. Ebenso ist bekannt, dass eine langsame Fließgeschwindigkeit der Bohrflüssigkeit gefährlich sein kann, wenn große Korngrößen transportiert werden müssen, da sie dazu tendieren sich im Bohrloch abzusetzen. Je langsamer der Bohrkleinrückfluss ist umso kleiner die Korngröße welche von der Flüssigkeit transportiert werden kann (bei gleichen rheologischen Eigenschaften).

Die existierenden Probleme mit dem im Bohrloch zurückbleibenden Abraum führen zu größeren Überschnittdimensionen oder mehreren Säuberungsdurchgängen um zu verhindern, dass Rohre beim Rückzug stecken bleiben.

HDD - savoir-vivre - in network and pipeline construction

Übermäßiges Pumpen von Bohrsuspension kann zudem zu ungewollten Ausbläsern führen, wenn der benötigte Pumpdruck größer als der maximale Bohrloch-Druck ist. Mit steigender Pumprate wachsen auch die Komplexität und Anforderungen an die Bohrspülung und resultiert in einer aufwendigen Suspensions-und Formationskontrolle mit entsprechenden Anpassungsmaßnahmen auf dem Projekt.

Diese Präsentation zeigt eine Lösung, die auf die entsprechenden Probleme beim Bohrkleintransport eingeht und es gleichzeitig ermöglicht, die größeren Korngrößen des Vollschnittbohrwerkzeugs sicher ohne ein Absetzen und einem Ausbläserrisiko aus dem Bohrloch zu transportieren. Dies führt schlussendlich zu einer neuen Serie von HDD Werkzeugen welche eine Leistungssteigerung erzielen können bei einer gleichzeitigen Investitionskostensenkung.

Full face Hole opening- A new drilling tool increases the performance of HDD in hard rock

Michael Lubberger, Senior Product Manager Pipeline, Herrenknecht AG

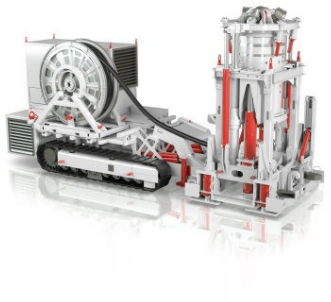
Marseille, 09 October 2015

Herrenknecht Introduction

Herrenknecht AG, Germany

- Founded in 1977
- Worldwide marked leader in mechanized tunnelling technology
- 4,600 employees worldwide
- Total output, 1,027 million Euro (2013)


SBX


Boxhole Machine


Raisebore Rig


AVN & AVND


EPB Shield


Gripper TBM


Single Shield

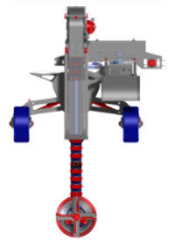

Double Shield

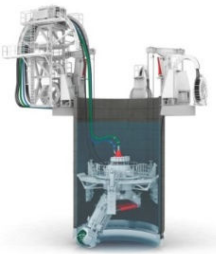

Partial-face Excavation Machine


Auger Boring Machine


HDD Rig


Direct Pipe®


Pipe Express®

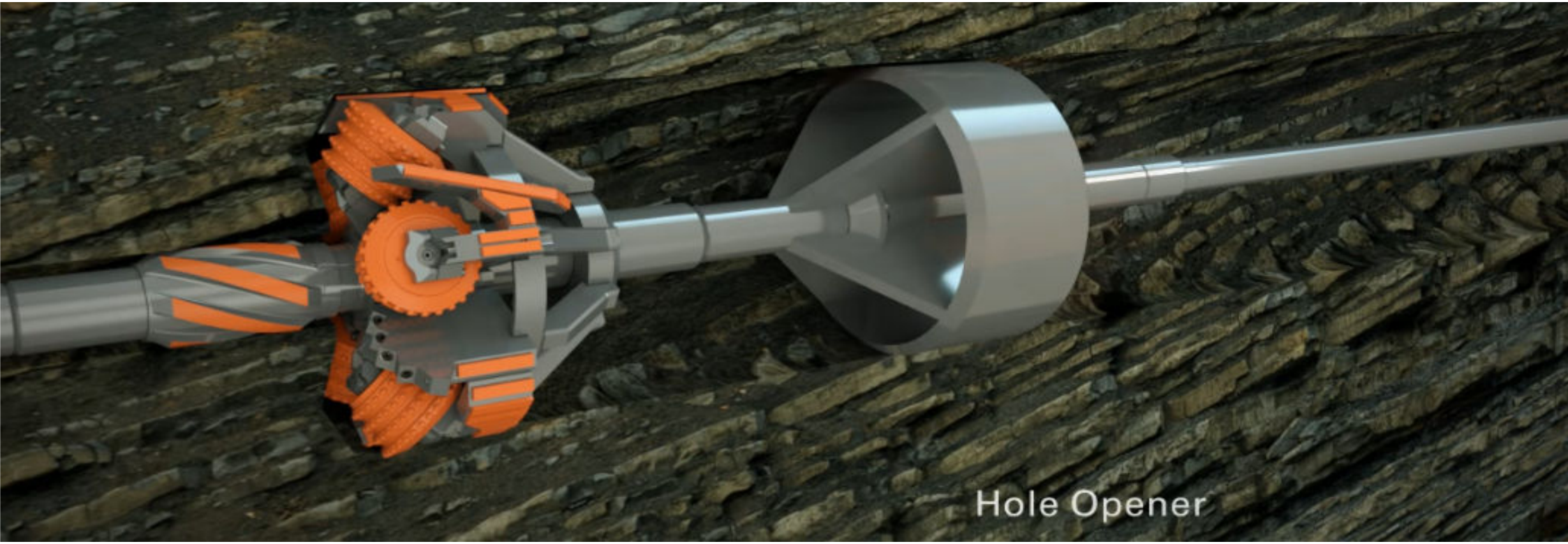

VSM

Herrenknecht Introduction

Herrenknecht Tunneling Systems USA Inc.

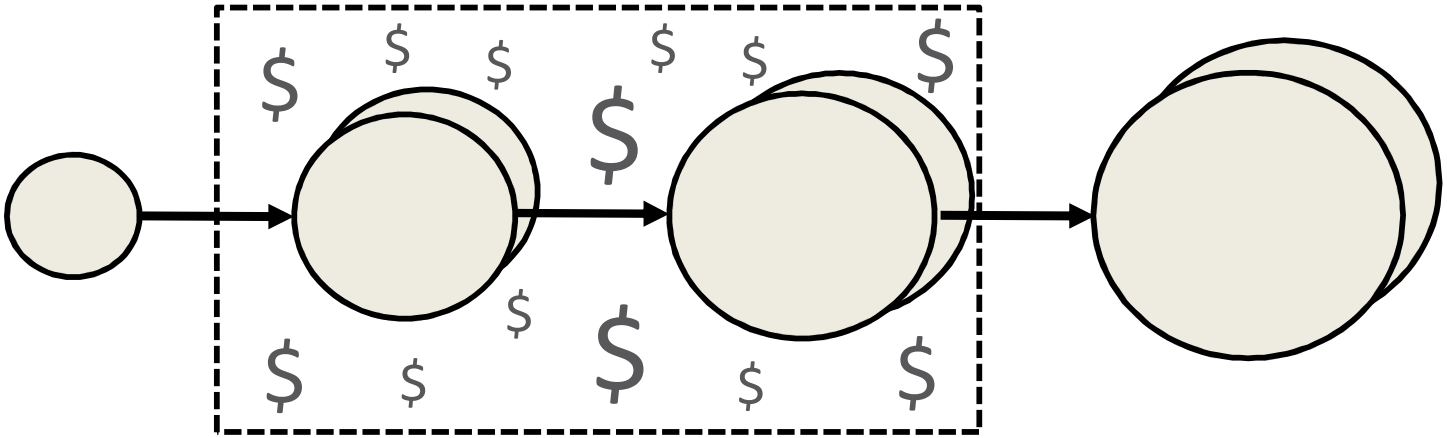
- Located in Sumner, Washington
- 35 employees
- **Sales and Service North America ,Cutting tools Worldwide**
  - Design of cutters, R & D of cutters
    - 6,5” to 20” diameter cutters
    - 80 different models
  - Manufacturing, Rebuilt & Stock of cutters
    - Approx. 10.000 cutters/year
    - Approx. Inventory level 7.0 Mio USD

Fullface vs. Conventional Reaming Steps

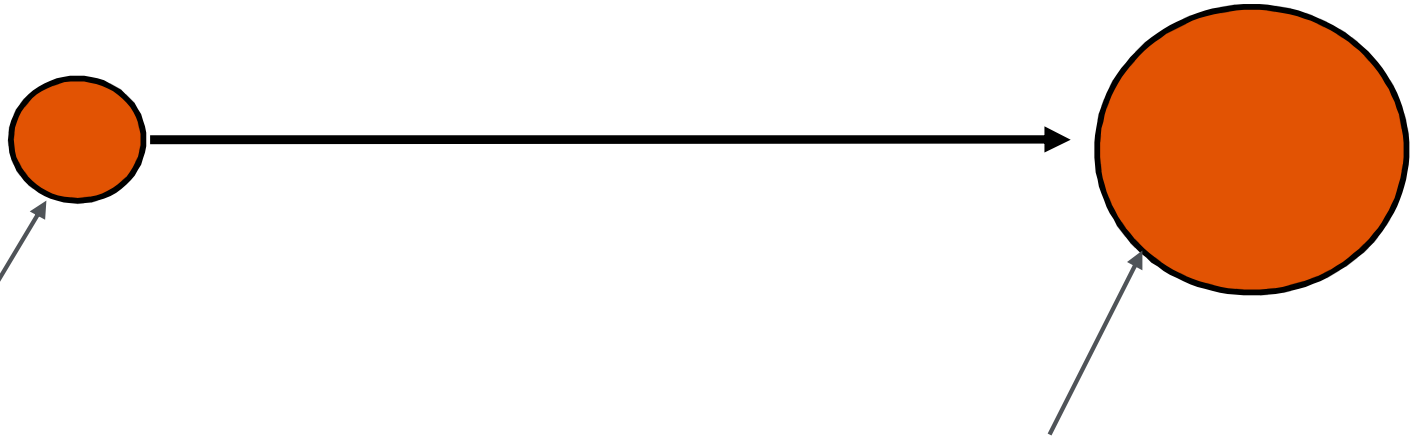


Fullface vs. Conventional Reaming Steps

Conventional



Fullface Hole Opening

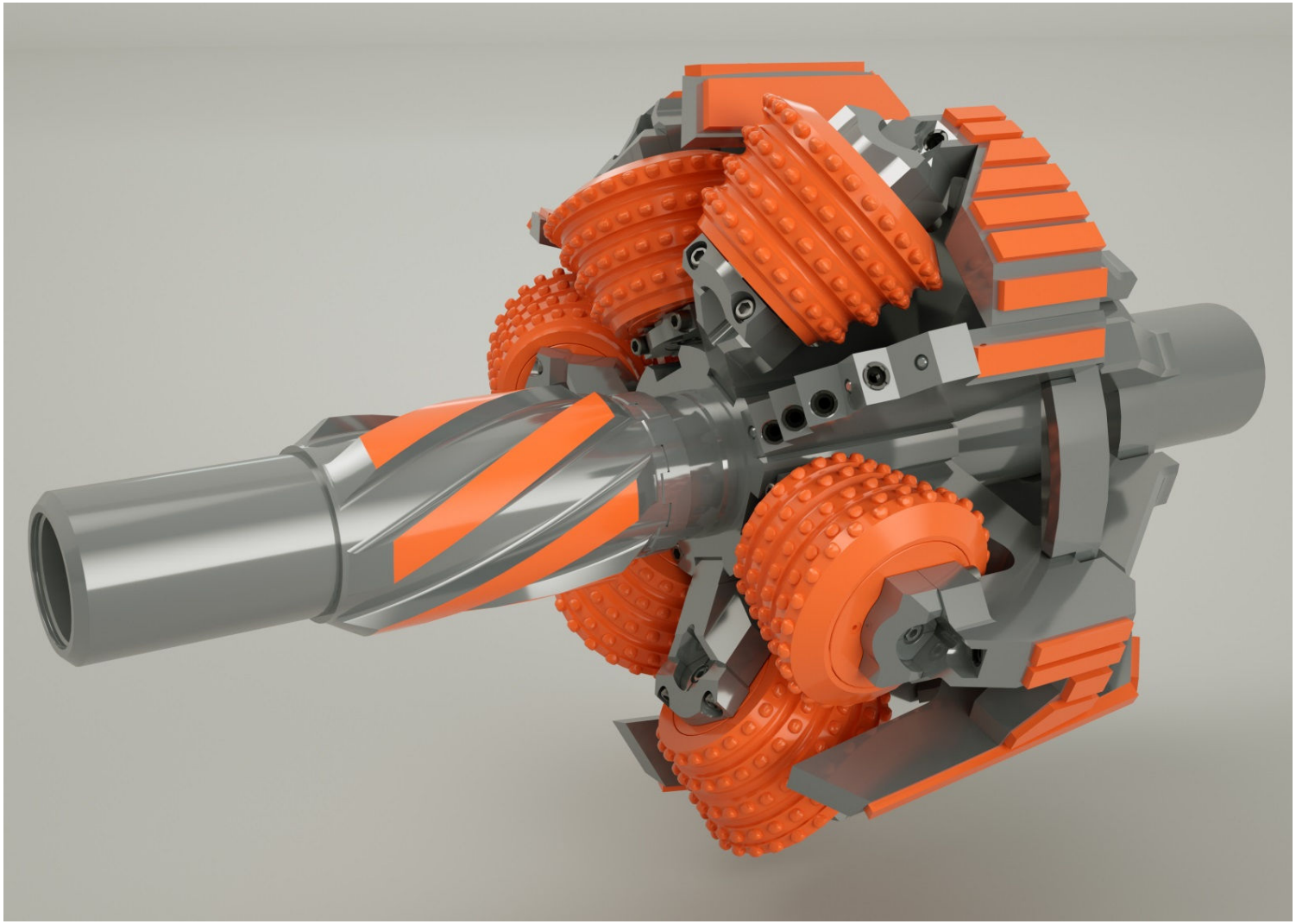


From min. 12 ¼”

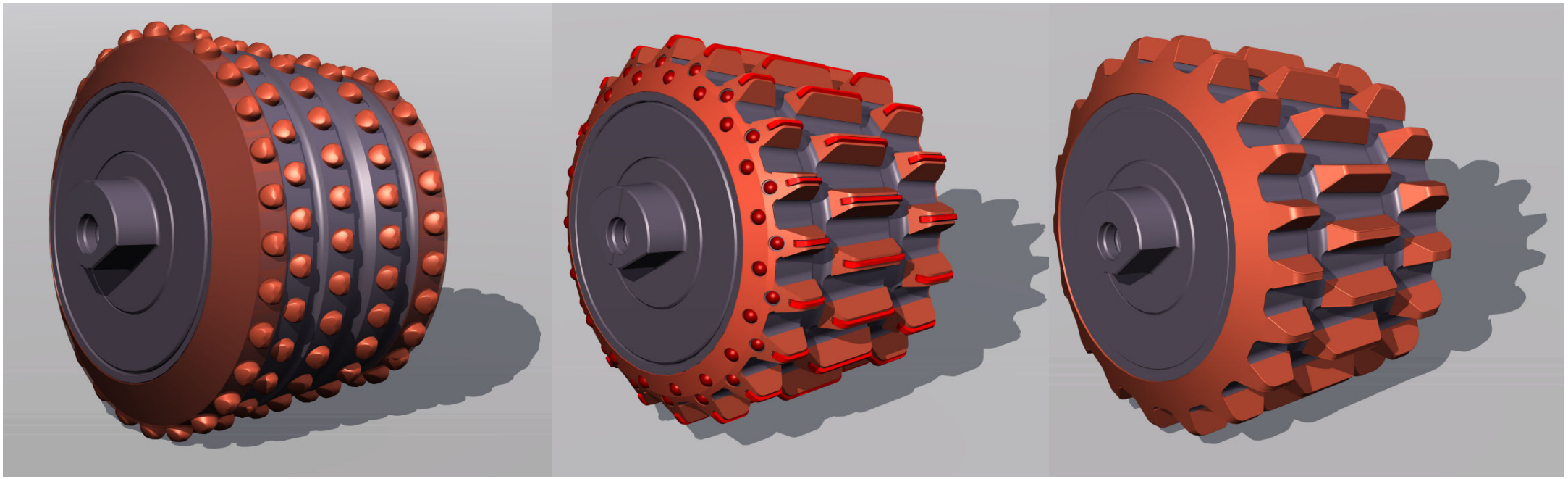
From min. 28”→ max. 72”

Hole Opener Design

- Replaceable Cutter
- Replaceable Front Centralizer
- Tool-Face Cleaning
- Cutting Scraper
- Non-Stick Coated Areas



Herrenknecht Fullface Hole Opener



Hard Rock (<R6) → **Soft Rock (>R0)**

- Replaceable parts, bearings, sealing (Service)
- Pressure-compensated
- Big bearing assembly for higher weight on bit
- HK offers assistance with the selection by own Geotechnical Dep.

Herrenknecht Fullface Hole Opener

Reasons for the Fullface Hole Opening development

- Continuous increase of drill pipe dimensions

  5” → 5 ½“→ 6 5/8“ → 7 5/8“ → 8 3/4“→ 9 5/8“

- Continuous increase of pilot bore diameters: 12 1/4” → 17“
- Development of “high torque” connections

  5 ½“FH DS→ 6 5/8“FH DS → 7 5/8“H-90 DS

  Min. recommended Make-up torque: 148,000 ft./lbs (200,000 Nm)

- Continuous increase of Rig Rotary and Push/Pull power:

  Push/Pull: 1,800,000 lbs. (800 to) ; Torque: 220,000 ft./lbs. (300,000 Nm)

- Tandem Operations of two Rigs on one drill string
- Continuous increase of Mud handling equipment size (Pumps & Recycling)
- High pricing & risk of HDD in Hard rock compared to other Drilling techniques

Efficiency through Cost reduction

- Less drilling tools needed
- Drilling tools with replaceable cutters
- Cutters with longer bearing and hub lifetime
- Effective wear protected body for a longer lifetime

→ **Saving investment costs**

- Less tripping operations
- Less joint changes
- Less tool changes
- Less cleaning runs
- Increased productivity

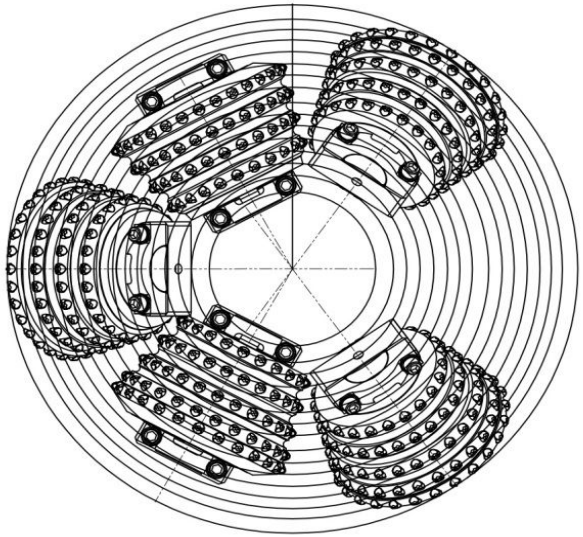
→ **Saving construction costs**

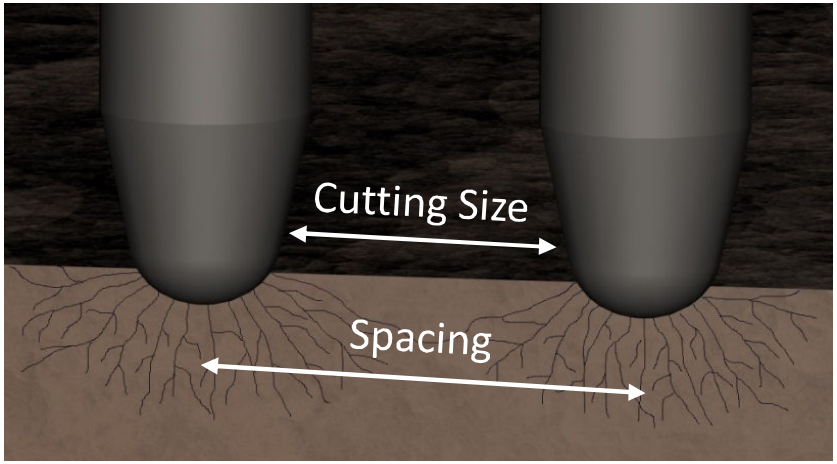
→ Less Costs-per-foot

Parameters to increase the productivity in Rock

- Cutter type/shape and spacing
- Rotations per minute
- Weight on bit (WOB)
- Cleanliness of the Toolface
- Cutting Transport through the Hole Opener

→ **Cutting Size** → **Rate of Penetration (ROP)**





Parameters to increase the productivity in Rock

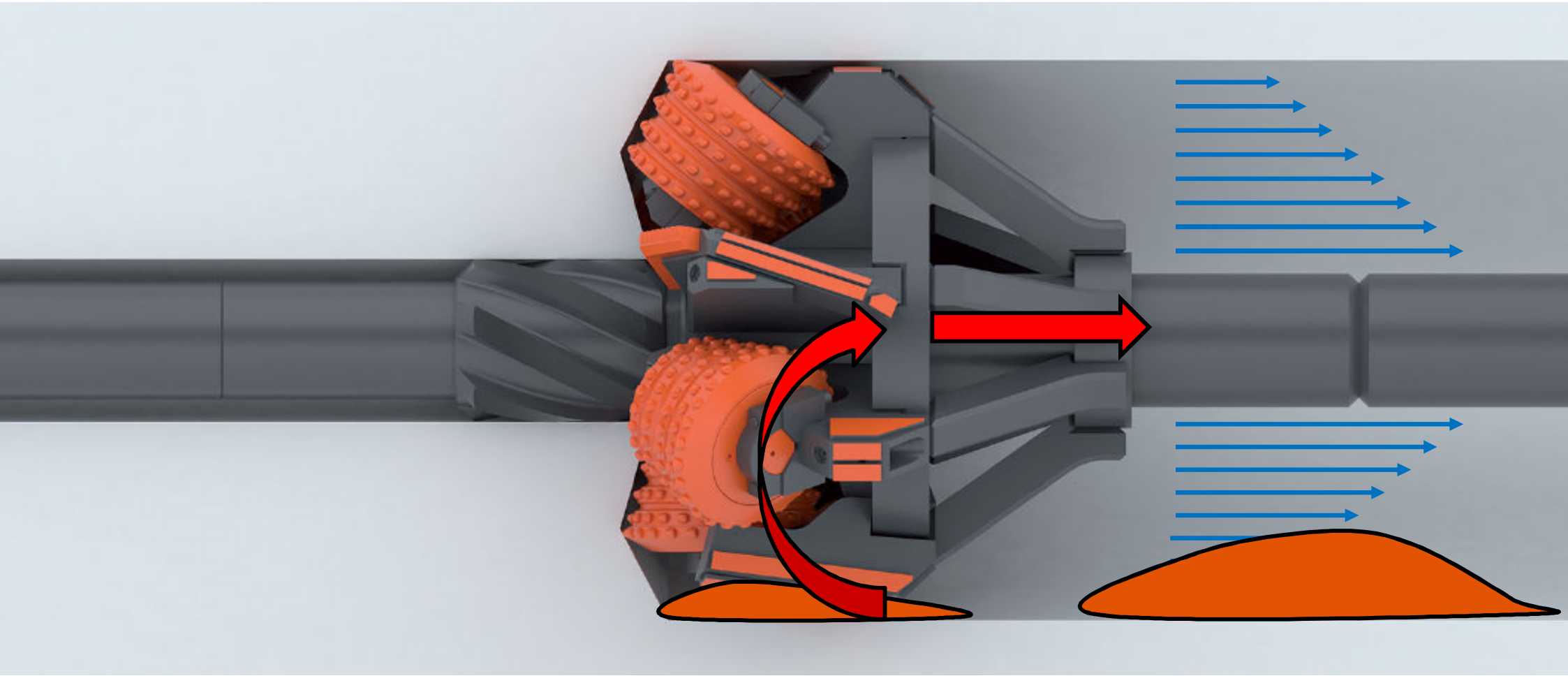
Introduced Energy (crushing/grinding)

Low → **High**

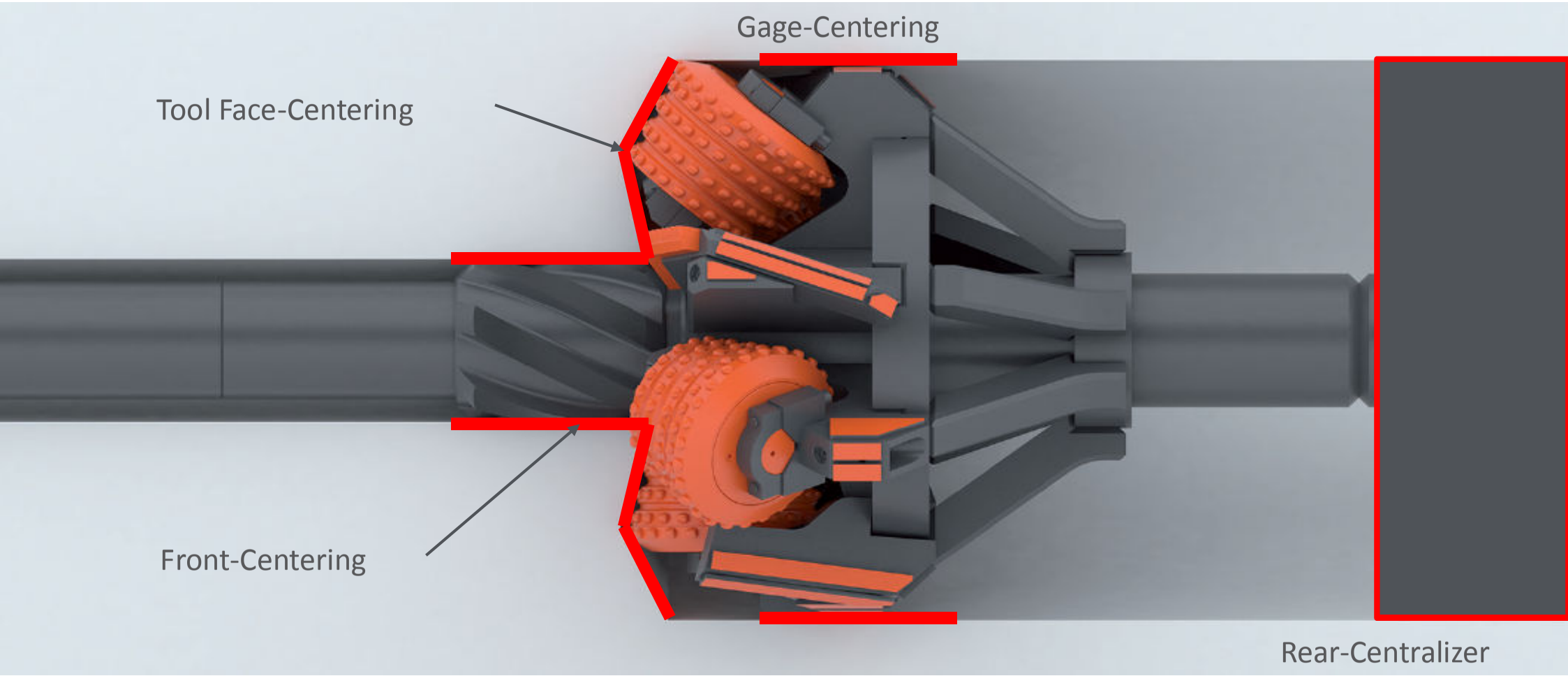
Wear on Tooling/Screens/Pumps

- Large Cuttings
- Small Cuttings

Mud & Cutting Flow



Centralization



Centralization

- Key hole shaped borehole after several conventional reaming passes

Open Design

Project References

- Fullface diameter: 42” & 48”
- Product diameter: 30” & 36”
- Pilot bores: 12” & 17”
- TCI & MT Cutters
- Granite, Basalt, Shale & Limestone

Challenges for the (Fullface) hole opening

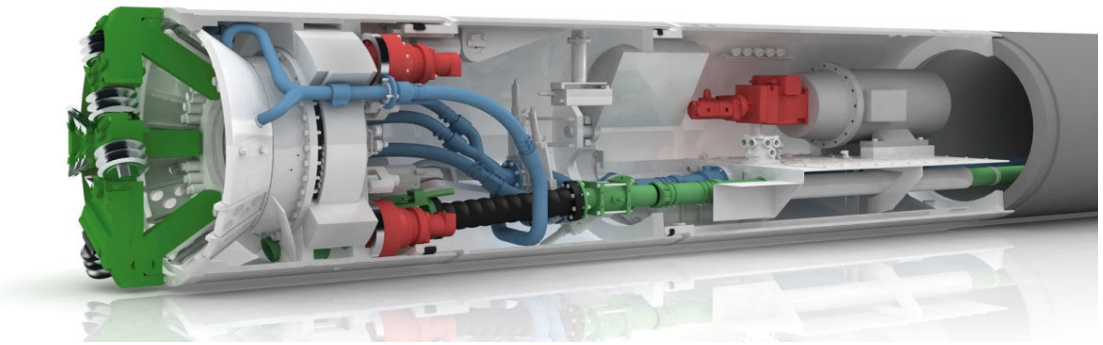
- Large Cutting transport
  - Risk of Settlements in the borehole
- Frac-out risk
  - Over pressurizing of the borehole
- Fluid losses
  - Natural fractures & fissures in the formation
  - Elevation between Entry & Exit

Common Reasons for Frac-Outs

- Pressure inside the borehole must be higher than the pressure which is generated by the overburden formation and the surrounding ground water pressure
- Pressure is generated by:
  - Geodetic height
    - Density, Groundwater level
  - Friction losses during pumping thru borehole
    - Viscosity, density, flow rate, wall character, length, cross section

Borehole is used as a discharge line to transport cuttings!

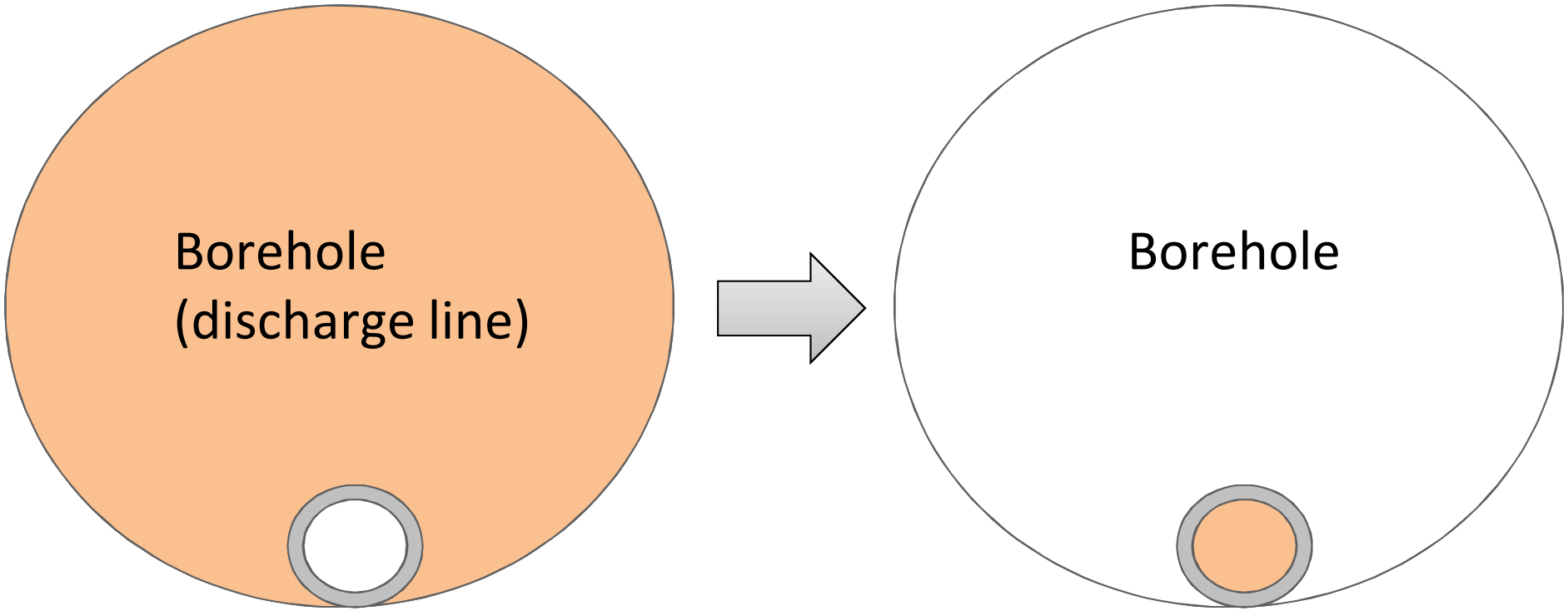
Velocity is key in hydraulic cutting transport



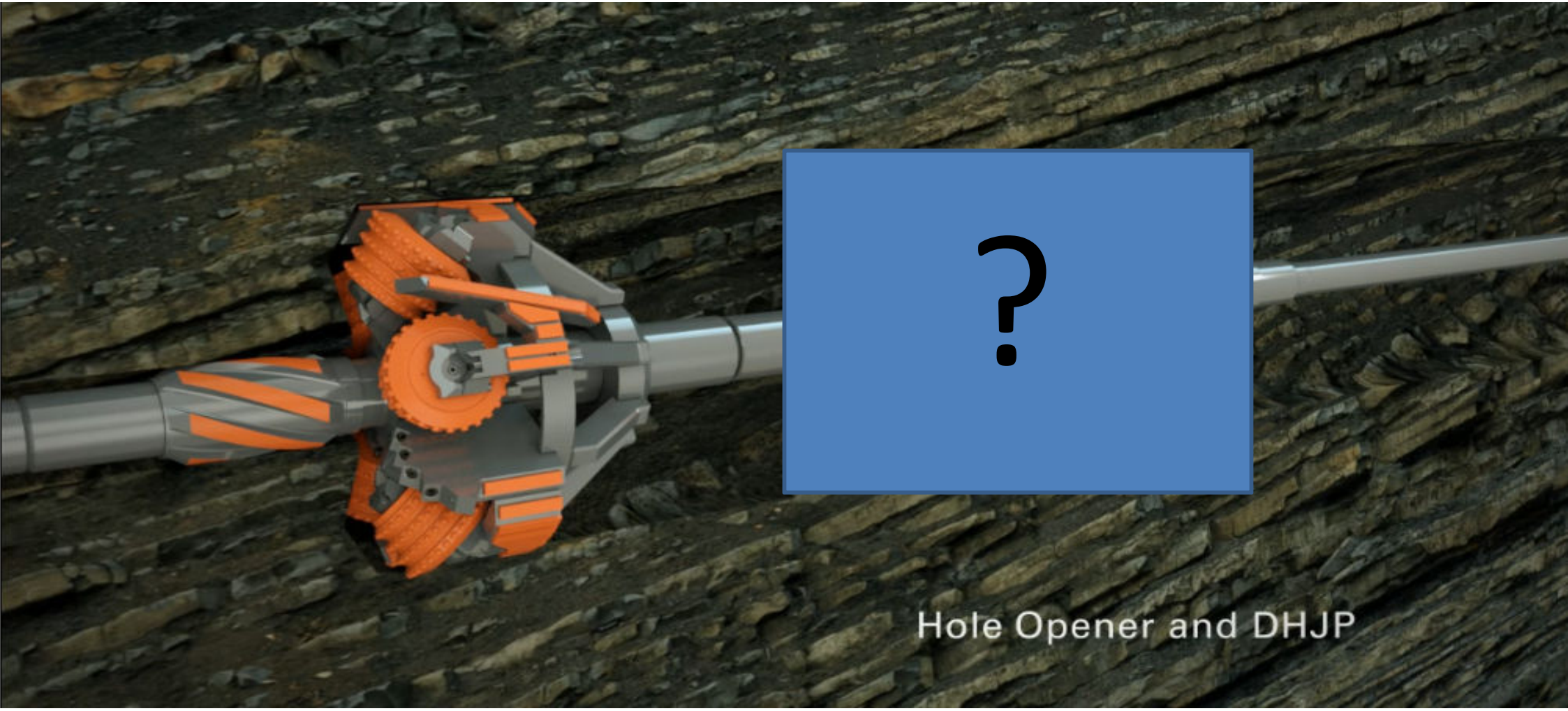
vs.

- Example - 42” Borehole:
  - HDD typical pump capacity 4.000 lpm→ 6 cm/s
  - MT typical pump capacity 1.800 lpm → 3000 cm/s (def. as critical velocity in MT)
  - Necessary pump capacity for HDD to reach critical velocity: 160.950 lpm (3000 cm/s)

Drill pipe used as discharge line

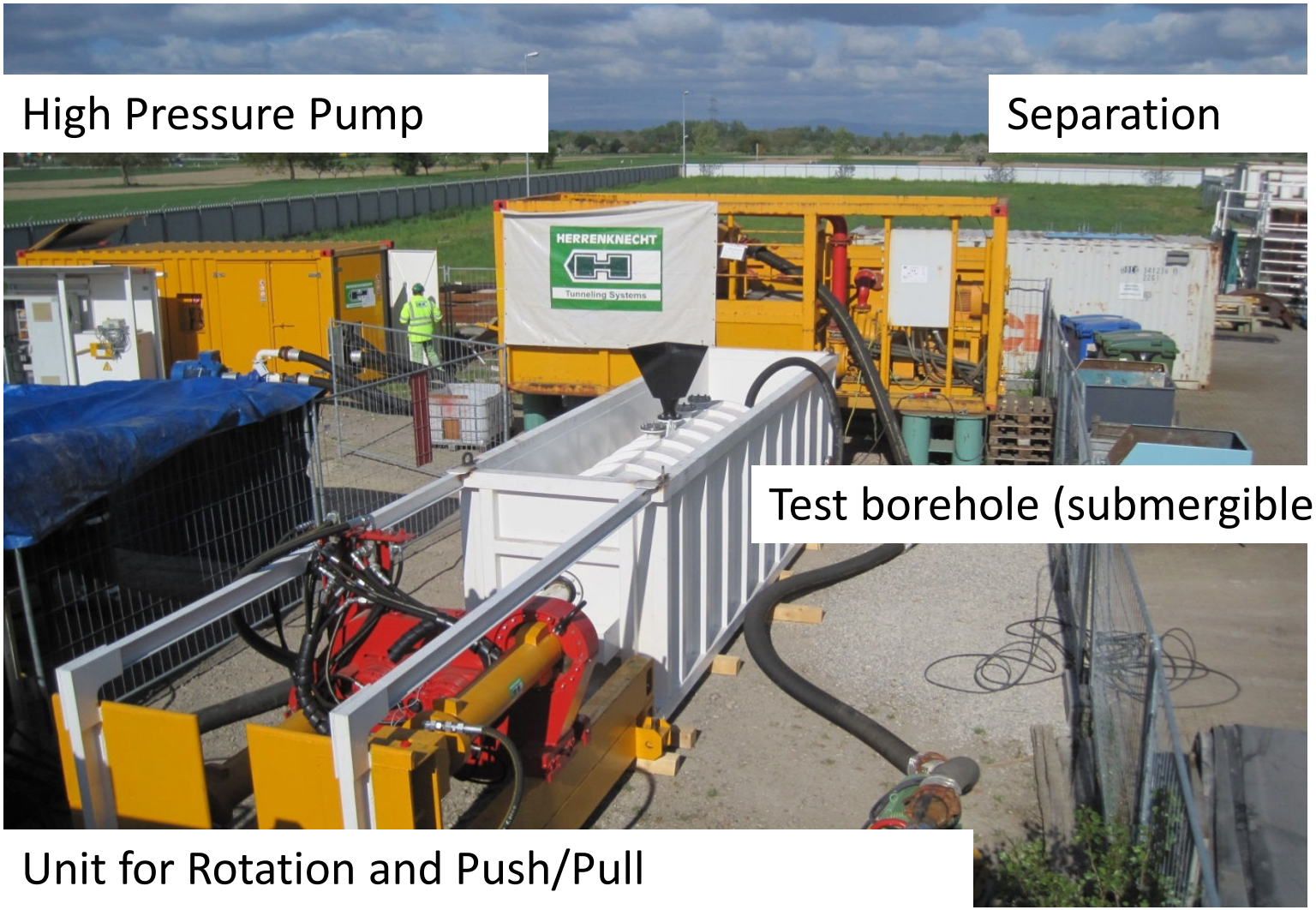


The missing Link: Down Hole Jet Pump (DHJP)




Down Hole Jet Pump

Herrenknecht DTH Tool Testing Facility



Herrenknecht DTH Tool Testing Facility

1000m of discharge line circuit

Herrenknecht DTH Tool Testing Facility

- DHJP in artificial borehole loaded with cuttings (dry))

- DHJP in artificial borehole after the testing (dry)

Herrenknecht DTH Tool Testing Facility

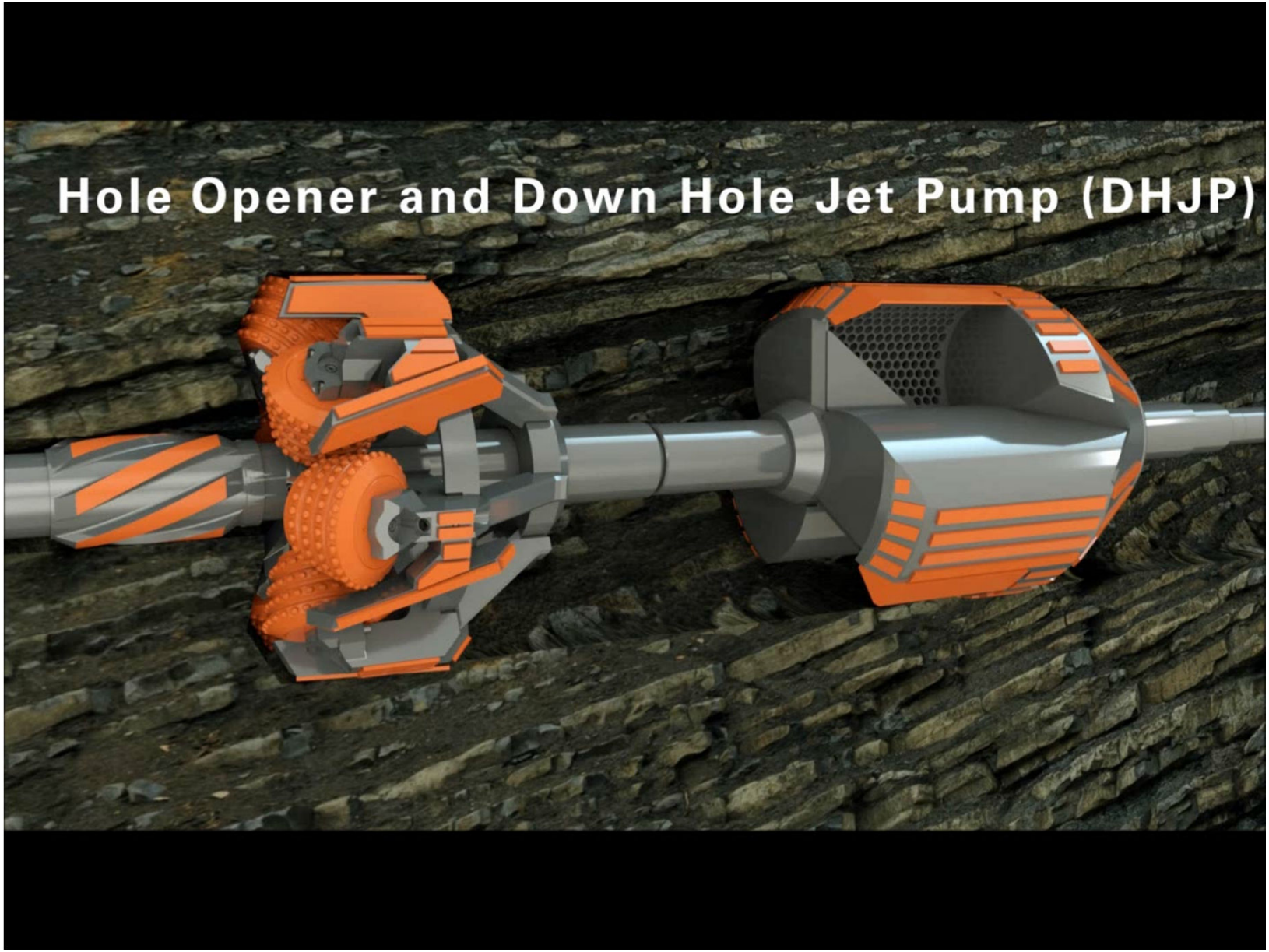
Requirements to operate an DHJP

- Min. Borehole diameter: 20” = 508 mm
- HP-Motive Flow:2000-2500 l/min
- HP-Motive Pressure: 50-60 bar
- Separation capacity: 3000-3500 l/min
- Recommended Drill Pipes: 6 5/8”
- Pipesite-swivel
- Mudreturnline (Pipesite-Rigsite)

All Advantages at a glance

- Minimum frac-out risk during the reaming operation in HDD
- Possibility to use a simple and cost saving mud program
- It is possible to create a 98% clean borehole
- Immediate formation feedback on the separation plant (1000m = 7 min)
- Possibility to transport larger cutting sizes
- Possibility for full-face reaming
- Works with non or partially filled boreholes
- Defined return flow direction
- Flow amounts (in & out the borehole) can be simply monitored and logged
- Direct connection of the mud flow to the recycling unit (No mud pit pump necessary)

Full Face Hole Opener & DHJP



- Please feel free to ask questions or give comments.

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1. The Challenges of the feasibility study

The success of a directional drilling job site is dependent on many factors :

Experience taught us that a lack of knowledge of the soil conditions was prejudicial to a well achievement of the directional drilling site. This lack of knowledge concerning geological and geotechnical context may cause technical difficulties and financial problems, even a failure which could call into question the success of the whole job site.

The main factor that could affect the feasibility of a project is the geological and geotechnical soil context.
A good knowledge of the physical and mechanical soil conditions is vital but not sufficient. The geometrical distribution of the different soil layers all along the bore path layout is absolutely necessary.

This information will enable the drilling contractor to define the bore path layout and the technical characteristics of the equipment to be used.

- The bore path layout should be compatible with the characteristics of the drilling tools and the acceptable bend of the product pipe.
- Size of the casing when it is necessary
- Drill head
- Mud motor
- Reamers
- Drilling fluid capability
- Product pipe coating

The engineer responsible of the feasibility study has European, international and national standards at his disposal to achieve his mission :

- Eurocode 7 as European standard
- NF P 94-500 as French standard, concerning the series of the geotechnical missions
- ASTM F1962-11 as American standard (Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of PE pipe or Conduit Under Obstacles, Including River Crossing)
- The technical manual from D.C.A

2. French and European standards

The European Eurocode 7 is totally devoted to the basic rules of the geotechnical calculation.

Reading this document shows us that is is not adapted to the study of a longitudinal project, which require a most global study, including the regional and local geological context.

A reliable study of a directional drilling project suppose many technics in order to have a global approach, so that the risks would be reduced.

Thus any study should begin by :

- A bibliographic investigation completed by a visit on site
- A geophysical survey
- Tests and corings in situ
- Tests in laboratory in order to know the soils and rocks

This process is complex, but ensures to have the best definition of the geological context concerning the drilling project.

The French standard complete the Eurocode 7 by suggesting a series of geotechnical missions which develop gradually the feasibility study.

This process is intended to control the risks and to plane the bore path layout of the drilling by taking into account the geological and geotechnical context but also to enable the contractor to consider and carry out the work with the maximum of information.

This standard is organized in two steps :

- The first step, under the responsibility of the contracting authority or the project supervisor, realization of the preliminary studies in order to have a feasibility file.
- The second step is distributed between the project supervisor and the contractor, concerns the work phase.

The first step is organized in two kinds of missions :

- G1 : geotechnical study mission that enables to definite :
  - The preliminary geological type and the identification of the first risks
  - The parameters to be taken into account for the geophysical and geotechnical study

- G 2 : geotechnical study of conception. This mission is organized in three steps :

- First : adjustment of the proposed project (G2AVP) in order to complete the geotechnical model and identify the risks as well as the effects on the drilling project
- Second : project mission (G2PRO) to definite the geotechnical hypothesis for writing the technical notices and make choices for the construction.
- Third : this mission (G2 DCE) concerns the writing of the technical documents intended to the drilling firms in order to achieve the execution file.

The second step is organized in two missions :

- G3 mission : supported by the contractor, it concerns essentially the writing of the calculation notes, (during the job) and the survey during the job of the characteristics of the geotechnical model chosen for the project
- G4 mission : supported by the contracting authority, it concerns the accreditation of the executing documents and the supervision of the geotechnical survey of the works.

These series are all the more important that the works engaged are more important and take more place than the traditional foundation works concerned by the Eurocode 7.

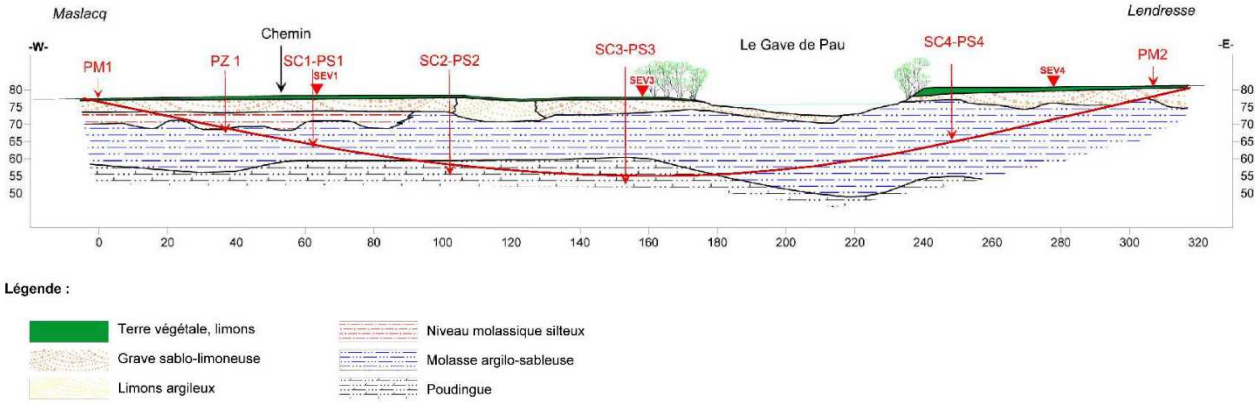
A spatial vision of the different facies and geological layers is essential during a drilling job site.

The mind of this standard with the series of missions described above is to have the possibility during the works to adapt the way of construction.
This suppose a continuous verification of the good alignment between the forecast and the reality of the behavior of the drilling.

This standard and the series of missions are complex because of the particular environment, the spatial spreading, and because the mineral world is alive :

- Natural or artificial fluctuation of the groundwater
- Landslide due to artificial or natural flow
- Natural erosion
- Anthropogenic disturbance
- Destabilization of the environment due to the activity of the tools and to the drilling mud
- Lateral fluctuations of the facies
- Etc …

Within a directional drilling, the feasibility study during the project phase should enable to establish a geological and geotechnical profile and describe the whole of the different facies and discontinuities encountered.



The analysis of the vulnerability of the work to construct depends on the characteristics of the formations. It is feasible only with the geological/geotechnical profile.

Only the combination of the results of the geophysical study with the results of the recognition survey, the results of the tests in-situ as well as the tests in laboratory could enable to construct the synthetical profile.

Concretely, the implementation of this standard within the HDD framework require some adjustments in the definition of the different missions.

Efforts will be accepted by all parties :

- By the contracting authority and the supervisor project, respecting scrupulously steps 1 and 2 and making do a G4 mission. This will mean for the supervisor project to know the technics of directional drilling and to adapt each step of the standard to the specificities of the works to be realized.
- By the drilling contractor, realizing a G3 mission, which is the only way to ensure the traceability of his drilling operations.

This process, even well adapted to the feasibility studies of a directional drilling, is rarely respected by the whole stakeholders of a directional drilling job (Contracting authority, supervisor project, drilling contractor).

3. Proposal of a process adapted to directional studies

Specificities liable to the study of a directional drilling involve that the different steps of the standard should be adapted to the particular context of a directional drilling project.

The progress of the different steps could be as following :

➲ Step n° 1 : Feasibility study phase

This step is organized in three phases

- Phase n° 1 = G1 mission for preliminary study, including :
  - A site investigation including a minima
    - Bibliographical research
    - Visit on site
    - Establishment of an expectable geological schema
  - Establishment of the general construction principles :
    - The design of the bore path layout
    - Establishment of the geological and geophysical studies program
- Phase n° 2 = G2 mission : conception of the proposed project (G2 AVP), including a minima :
  - Geophysical investigations
  - Geotechnical investigations
  - Geological profile construction
  - Identification of the geotechnical risks and the consequences on the work
- Phase n° 3 = G2 mission : conception of the project (G2 PRO), including a minima :
  - Synthesis of all the data collected
  - The effects of the geological context on the choice of one or another technique implemented
  - Finalization of the technical recommendations
  - To write the technical notices justifying the construction choices

➲ Step n° 2 : Work phase :

The work phase is divided into two missions, one ensured by the contracting authority or the supervisor project, and the other by the drilling contractor.

- G3 mission = supported by the drilling contractor, including :
  - Writing of the execution operating procedures and the calculations notes
  - Follow-up of the works and clear daily traceability of the progress of the drilling
    - Daily report
    - Drilling report for each joint
    - Mud report
    - Survey report
- G4 mission = supported by the contractor authority, it is a mission of project management, or project management assistance and includes two points :
    - Carrying out phase, including an opinion on the relevance of the geotechnical carrying out study file and on the adjustment or the optimizing of the geotechnical works proposed by the contractor
    - Carrying out survey phase, including supervision of the geotechnical survey, an opinion on the relevance of the geotechnical model chosen and the progress of the works

This conceptual model of feasibility study and works survey enable to study and to manage the realization of a complex directional drilling and to anticipate the possible technical problems as well as the financial excesses.

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1. LES ENJEUX DE L'ETUDE DE FAISABILITE - THE CHALLENGES OF THE FEASIBILITY STUDY

Le succès d'un chantier de forage dirigé dépend de nombreux facteurs.
L'expérience nous a enseigné qu'une méconnaissance des conditions de sol était préjudiciable au bon déroulement d'un chantier de forage dirigé. Cette méconnaissance du contexte géologique et géotechnique est à l'origine de difficultés techniques et de dérives financières ou même d'un échec remettant en cause le succès de la totalité du chantier.

Le principal facteur qui affecte la faisabilité d'un projet est représenté par le contexte géologique et géotechnique du sol.
Une bonne connaissance des conditions physiques et mécaniques du sol est primordiale mais pas suffisante. La répartition géométrique des différentes couches de sol le long du tracé du forage est absolument nécessaire.

Ces informations permettront (à l'entrepreneur) de définir le tracé du forage (bore path layout) ainsi que les caractéristiques techniques du matériel à mettre en œuvre :

- Le tracé du forage doit être compatible avec les caractéristiques des outils de forage à mettre en œuvre et le rayon de courbure admissible de la conduite (product pipe) ;
- Dimension du casing lorsqu'il est nécessaire ;
- Tête de forage (drill head) ;
- Moteur à boue (mud motor) ;
- Aléseurs (reamers) ;
- Caractéristiques du fluide de forage (drilling fluid capability) ;
- Type de revêtement de la conduite (product pipe coating).

L'ingénieur chargé de l'étude de faisabilité a à sa disposition des normes Européennes, internationales et nationales pour effectuer sa mission.

Il s'agit des textes suivants :

- L'Eurocode 7 en tant que norme Européenne ;
- La norme NF P 94-500 en tant que norme française concernant l'enchainement des missions géotechniques ;
- La norme Américaine ASTM F1962-11 (Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of PE pipe or Conduit Under Obstacles, Including River Crossing)
- Le guide technique du D.C.A

2. LES NORMES FRANÇAISES ET EUROPEENNES – FRENCH AND EUROPEAN STANDARDS

La norme Européenne Eurocode 7 se consacre exclusivement aux règles fondamentales du calcul géotechnique. Elle définit dans sa section 2 les bases du calcul géotechnique.

A la lecture de ce document, on s'aperçoit qu'il est inadapté à l'étude d'un projet longitudinal qui nécessite une étude plus globale prenant en compte le contexte géologique locale et régional.

Une étude sérieuse d'un projet de forage dirigé fait intervenir plusieurs techniques dans le cadre d'une approche globale destinée à réduire au maximum les risques.

Ainsi toute étude doit débuter par :

- Une enquête bibliographique complétée par une reconnaissance de terrain ;
- La réalisation d'une campagne de reconnaissance géophysique ;
- La réalisation de sondages et essai in-situ ;
- La caractérisation des sols et roches par des essais en laboratoire.

Ce processus est complexe pour pouvoir définir du mieux possible le contexte géologique dans lequel s'inscrit le forage dirigé à réaliser.

La norme Française vient compléter astucieusement l'Eurocode 7 en proposant un enchainement de mission géotechnique qui permet de faire évoluer l'étude de faisabilité d'une manière progressive.

Ainsi ce processus est destiné à maitriser les risques et à tracer le profil du forage dirigé en tenant compte du contexte géologique et géotechnique mais également à permettre à l'entrepreneur d'évaluer et de réaliser les travaux avec le maximum d'informations.

Cette norme s'organise autour de deux étapes :

- La première étape à la charge du maitre d'ouvrage ou du maitre d'œuvre concerne les études préalables pour aboutir à un dossier de faisabilité en phase projet ;
- La seconde étape est répartie entre le maître d'œuvre et l'entrepreneur et concerne la phase chantier.

La première étape s'organise autour de deux types de missions :

- Mission G1 d'étude géotechnique qui permet à travers une étude bibliographique et de terrain du site du forage dirigé de définir :
  - Le modèle géologique préliminaire et d'identifier les premiers risques ;
  - Les paramètres à prendre en compte dans le cadre de l'étude géotechnique et géophysique.

- Mission G2 d'étude géotechnique de conception. Cette mission s'organise autour de trois phases :
  - Une phase de mise au point d'avant-projet (G2 AVP) destinée à compléter le modèle géotechnique et identifier les risques et ses conséquences sur l'ouvrage à construire ;
  - Une phase projet (G2 PRO) qui permet de définir les hypothèses géotechniques nécessaires à l'établissement des notes techniques et aux choix constructifs ;
  - Une troisième phase (G2 DCE) qui concerne la rédaction des documents techniques aux entreprises pour la rédaction du dossier d'exécution.

La seconde étape s'articule autour de deux missions :

- Mission G3 à la charge de l'entrepreneur qui concerne essentiellement l'établissement des notes de calcul (phase exécution) et le suivi en cours de chantier des caractéristiques du modèle géotechnique retenu pour le projet ;
- Mission G4 à la charge du maître d'ouvrage qui concerne la validation des documents d'exécution et la supervision du suivi géotechnique des travaux.

Cet enchainement est d'autant plus important que les travaux engagés s'étalent sur un espace bien plus grand que les traditionnels travaux de fondation et/ou de terrassement qui sont concernés par l'Eurocode 7.

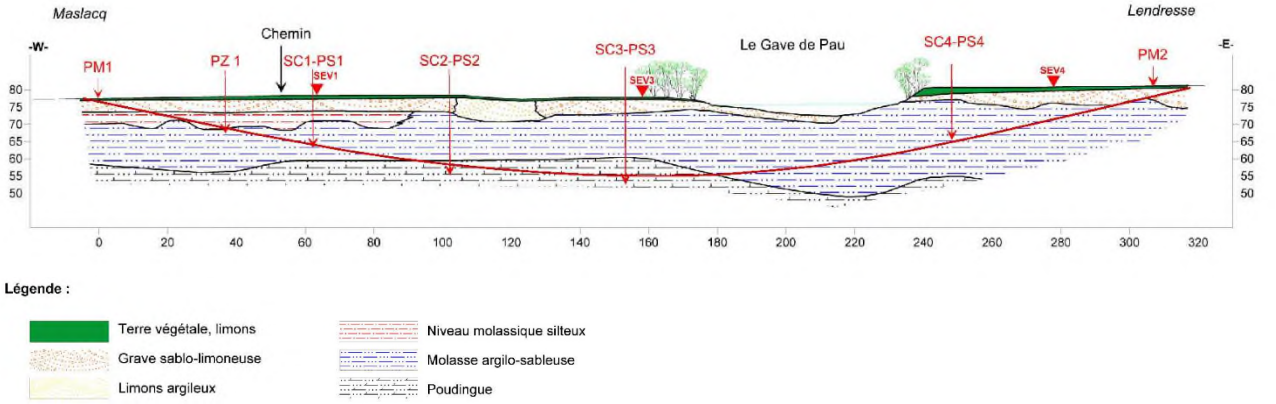
La vision spatiale de la géométrie des différents faciès et couches géologiques revêt une importance primordiale dans le déroulement d'un chantier de forage dirigé.

L'esprit de cette norme à travers l'enchainement des missions qui ont été décrites ci-dessus est de permettre l'étude en cours de travaux des possibilités d'adaptation de la méthode de construction.
Cela suppose une vérification en continue de la bonne concordance entre prévision et réalité du comportement de l'ouvrage.

La mise en œuvre de cette norme et de l'enchainement des missions est complexe car le milieu dans lequel s'inscrivent ces travaux et particulier en raison de son étalement spatial et que le monde minéral est un monde vivant :

- Fluctuation naturelle ou artificielle de la nappe phréatique ;
- Entrainement de fines sous l'effet d'écoulements artificiels ou non ;
- Phénomènes naturels d'érosion ;
- Perturbations anthropiques ;
- Déstabilisation du milieu sous l'action des outils et fluides de forage ;
- Variations latérales de faciès ;
- Etc …

Dans le cadre spécifique d'un forage dirigé, l'étude de faisabilité en phase projet doit permettre l'établissement d'un profil géologique et géotechnique et qualifier l'ensemble des différents faciès et discontinuités rencontrés.



L'analyse de la vulnérabilité de l'ouvrage à construire dépend des caractéristiques des formations qui sont mobilisées. Elle ne peut se faire qu'en disposant de l'ouvrage à réaliser et du profil géologique/géotechnique.

Dans un tel contexte, seul la combinaison des résultats de l'étude géophysique avec les résultats de la campagne de sondage de reconnaisse, des essais in-situ et des essais en laboratoire permet de construire le profil synthétique.

Concrètement, la mise en œuvre de cette norme dans le cadre de travaux sans tranchées nécessite quelques adaptations dans la définition des différentes missions.

Les efforts doivent être consentis par toutes les parties :

- Par la maîtrise d'ouvrage et la maîtrise d'œuvre en respectant scrupuleusement des étapes 1 et 2 et en assurant une mission G4. Cela suppose pour le maître d'œuvre de maitriser les techniques de forage dirigé et d'adapter le contenu de chaque étape de la norme aux spécificités des travaux à réaliser ;

- Par l'entreprise de travaux en assurant une mission G3 seule capable d'assurer la traçabilité de ses opérations de forage

Ce processus, pourtant bien adapté au contexte des études de faisabilité d'un forage dirigé est très rarement suivi par l'ensemble des acteurs d'un chantier de forage dirigé (Maitres d'ouvrages, maitres d'œuvres et entrepreneurs).

3. PROPOSITION DE PROCESSUS ADAPTE AUX ETUDES DE FORAGE DIRIGE – PROPOSAL OF A PROCESS ADAPTED TO DIRECTIONAL STUDIES

Le contexte particulier de l'étude d'un forage dirigé mérite que les différentes étapes de la norme soient adaptées au contexte particulier d'un projet de forage dirigé.

Le déroulement des différentes étapes serait alors le suivant :

➲ Etape n° 1 : Phase étude de faisabilité

Cette étape se décompose en trois phases :

- Phase n° 1 = mission G1 d'étude préalable. Elle comprend :
  - Une phase d'étude du site avec à minima :
    - Une recherche bibliographique,
    - Une visite du site,
    - L'établissement d'un schéma géologique prévisible
  - L'établissement des principes généraux de construction :
    - Le design du tracé du forage dirigé ;
    - La définition du programme de reconnaissance géologique et géophysique.
- Phase n° 2 = Mission G2 de conception d'avant-projet (G2 AVP) comprenant à minima :
  - Les investigations géophysiques ;
  - Les investigations géotechniques ;
  - La construction du profil géologique ;
  - L'identification des risques géotechniques et ses conséquences sur l'ouvrage.
- Phase n° 3 = Une mission G2 de conception de projet (G2 PRO) qui comprend à minima :
  - La synthèse des données recueillies ;
  - L'incidence du contexte géologique sur le choix de la ou des techniques à mettre en œuvre ;
  - La finalisation des préconisations techniques ;
  - L'établissement des notes techniques justifiant les choix constructifs.

➲ Etape n° 2 : Phase travaux :

La phase travaux se répartie en deux missions entre le maître d'ouvrage ou son maître d'œuvre d'une part et l'entreprise de travaux d'autre part.

- Mission G3 = à charge de l'entreprise de travaux, elle comprend :
  - L'établissement des modes opératoires d'exécutions et des notes de calcul
  - Le suivi des travaux et la traçabilité quotidienne précise du déroulement du forage :
    - Rapport journalier (Daily report)
    - Rapport de forage tige par tige (Drilling report for each joint)
    - Rapport de fluide de forage (Mud report)
    - Rapport de guidage (survey report)
- Mission G4 = à charge du maître d'ouvrage. Il s'agit d'une mission de maitrise d'œuvre ou d'assistance à maîtrise d'œuvre qui comprend deux volets :
  - Une phase exécution comprenant la fourniture d'un avis sur la pertinence du dossier d'étude géotechnique d'exécution et l'adaptation ou l'optimisation des ouvrages géotechniques proposés par l'entrepreneur ;
  - Une phase de suivi d'exécution comprenant la supervision du suivi géotechnique, la fourniture d'un avis sur la pertinence du modèle géotechnique retenu et le déroulement des travaux.

Ce modèle conceptuel d'étude de faisabilité et de suivi des travaux permet d'étudier et de gérer la réalisation d'un forage dirigé complexe et d'anticiper les éventuels problèmes techniques et dérives financières.

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Brazilian sea turtles watching gneiss HDD, 2014-2015

Alexis Filliette, Horizontal Drilling International, France

The Project :
The Rota Cabiunas shore approach was performed by HDI in Brazil for Petrobras and Intech in 2014 - 2015. The project consisted in the installation of a steel Gas pipeline 1300 meter long with diameter 24'' (28,3 mm wall thickness) under the littoral.

The total pipeline, in green above, is 380 km long, starts at a water depth of 2230 meters in the Santos Basin and will connect the Cernambi offshore gas field to the Cabiunas onshore refinery located in suburb of the petroleum city of Macae, north-east of Rio de Janeiro.

The Construction schedule:

Initially planned in 2013, the project has been postponed for more than a year and a half because of delays in obtaining from IBAMA the necessary environmental licenses for turtle's protection. These licenses and the construction permit were finally granted to Petrobras beginning of 2014.

The HDD project started then in May 2014.

The Resources:

HDI mobilized end of 2012 a complete 400 tons HDD spread including mainly:

Drilling Equipment Onshore:

- 400 tons rig
- 2 HP Pumps & 6 transfer pumps
- 1 Recycling
- 2 mud tanks
- 1 hydraulic break–out unit
- 1200 m 6"5/8 FH + 1300 m 5"1/2 FH drill pipes
- 1 Taurus pneumatic hammer

Offshore assistance (Brazilian):

- Barge 60 m * 25 m
- 80 tons winch
- 300 tons crane

The Geology:

The expected geology was as follows:

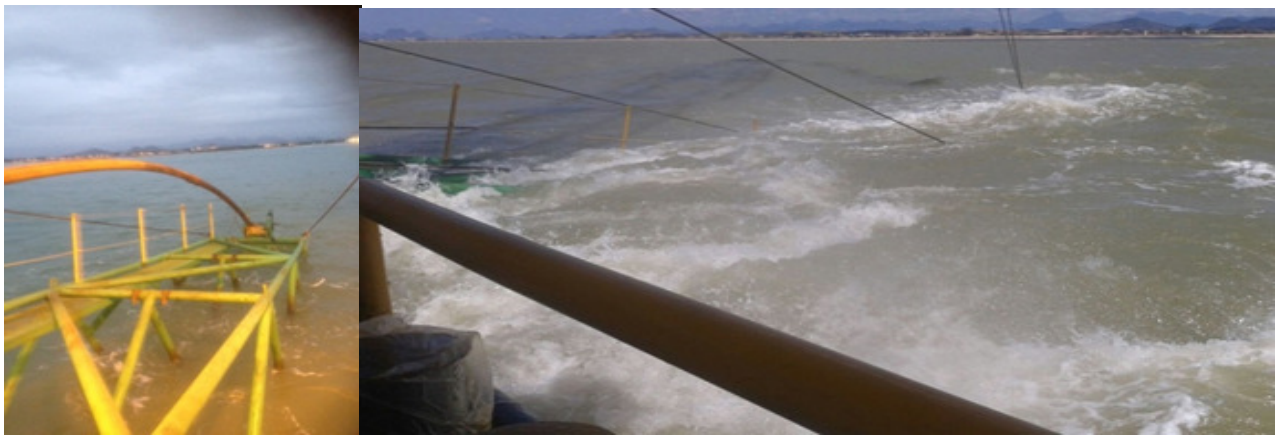
- Soft sandy alluvial entry section on 100 m
- Gneiss rock (70-120 Mpa) on 800 m
- Soft alluvial exit section in the seabed on 120 m

The Operations:

Casing / 20 days:
First step of the HDD operations was the installation of an inclined steel casing with diameter 44'' in order to consolidate the soft entry section. The gneiss bedrock was found at more than 200 meters from the entry point, which considerably complicated the installation of the entry casing. Facing the impossibility to install the casing down to the bedrock with the equipment initially foreseen, the problem was solved with the installation of a telescopic casing.

Pilot holes / 1 month in double shifts:
The second step was drilling the pilot hole, which incorporated a long horizontal curve to the left in order to exit in the sea aligned with the existing pipelines and inside the right of way granted by IBAMA to Petrobras.
A first hole, drilled with mud motor 8'' and tricone 12''1/4 had to be abandoned after 600 meters because of an unforeseen geological fault creating a deviation (breakage of radius) that could not be corrected. A second pilot hole was then drilled deeper, with full success.

Reaming / 7 month with double shifts:
Because of the sliding of the global planning, the hole opening passes had to be performed during a bad weather window with very difficult sea conditions.



These difficult sea conditions have heavily impacted the movement of the barge, damaging many drill pipes and other tools. The consequence was a loss of 2 1/2 months because of weather standby and repairs of the damages at the sea side.

In order to proceed safely with the works in spite of the adverse meteocean conditions, HDI developed a constant tension system for the offshore winch cable on the barge with a dead-weight system and a safety fuse.

Because of the greater depth at which the crossing had to be drilled, we faced a much harder rock with UCS in the range of 170-180 MPa, which slowed down the reaming speed, increased

the quantity of downhole tools necessary for the works and as a consequence increased the number of trip-out / tri-in operations to change the tools.

Great care was given to monitor the wear of the downhole tools in order to avoid the risk of losing an arm or a cone of hole opener in the drilled hole, which would have necessitated hazardous “fishing” operations, potentially very time consuming and costly, especially since consequent offshore equipment were mobilized and would have become on stand-by. In particular a special attention was devoted to controlling the Weight on Bit and the number of cones revolutions, all hole-openers being systematically tripped-out after 500.000 revolutions. In order to illustrate this, on a 36’’ hole opener equipped with 17’’ cones, each rotation of the tool generates 2,12 revolutions of the cones; with an average rotation speed of 35 rounds per minute, the 500.000 revolutions are reached after 112 hours of rotation with the tool on face.

The hole opening was performed for the main part with two concentric passes of 28’’ and 36’’, except for a section of the hole where the rock was extremely hard and required an intermediate step of 22’’.

Pull back / 1 week with double shifts:
Once the hole was entirely reamed to its final diameter of 36’’, the pipeline was successfully pulled with 140 tons, after a complex dragging operation in order to bring the pipe string (that was laid full of water on the sea bed 750 meters beyond the exit point) near the sea exit of the hole. The pipe being very heavy because of its important wall thickness and its 300 meters long concrete coated tail, the dragging operation required a particular procedure involving simultaneously the use of “parachutes” to reduce the weight of the pull head and the concrete tail, and combined pulling efforts of the barge (70 tons toward the surface) and the HDD rig (190 tons longitudinally) to “free” the pipe string and bring it until the entry into the drilled hole.

Conclusion:
Working in Brazil is not necessarily as idyllic as what postcards can let you believe! As in many countries nowadays, pipeline works necessitate numerous authorizations including environmental licenses, that can also heavily impact the HDD operations and that are totally out of control of the contractor. Furthermore, as with any offshore works, the meteocean conditions (wave height, wind, wave period, wave direction, etc.) must be carefully evaluated and specific offshore procedures must be developed to perform any HDD shore approach. This Rota Cabiunas project was the occasion for HDI to further develop its procedures, particularly with regards to the offshore assistance, in order to solve the technical challenges and finally give satisfaction to our client with a critical project delivered on time.

Atterrage dans du gneiss sous le regard des tortues Brésiliennes, 2014-2015

Alexis Filliette, Horizontal Drilling International, France

Le Projet :
L'atterrage de Rota Cabiunas a été réalisé par HDI au Brésil pour le compte de Petrobras et Intech en 2014-2015. Ce projet consistait en l'installation d'une conduite acier de gaz de 1300 m de long et de diamètre 24'' (28,3 mm d'épaisseur) sous le littoral Brésilien.

Ce pipeline long de 380 km, en vert ci-dessus, débute à une profondeur d'eau de 2230 mètres dans le bassin offshore de Santos pour connecter le champ gazier de Cernambi à la raffinerie terrestre de Petrobras basée Cabiunas dans la banlieue de Macae, au nord-est de Rio de Janeiro.

Le Planning:

Initialement prévu en 2013, le projet a été retardé de plus d'un an et demi du fait du retard dans l'obtention par Petrobras des licences environnementales (délivrées par IBAMA) pour la protection des tortues marines. Ces licences ont finalement été délivrées à Petrobras début 2014.

Le projet débuta donc en Mai 2014.

Les Ressources:

HDI a mobilisé un atelier complet de forage dirigé de 400 tonnes fin 2012, incluant principalement:

Forage Dirigé, à terre:

- Foreuse 400 tonnes
- 2 Pompes Haute Pression & 6 Pompes de transfert
- 1 Système de Recyclage complet
- 2 Bacs à boues (mixage et stockage)
- 1 clé hydraulique
- 1200 m 6''5/8 FH + 1300 m 5''1/2 FH de tiges de forage
- 1 marteau pneumatique Taurus

Assistance Offshore (Brésilienne)

- Barge flottante de 60 m * 25 m
- Treuil de 80 tons
- Grue de 300 tonnes

La Geologie:

La géologie attendue était la suivante :

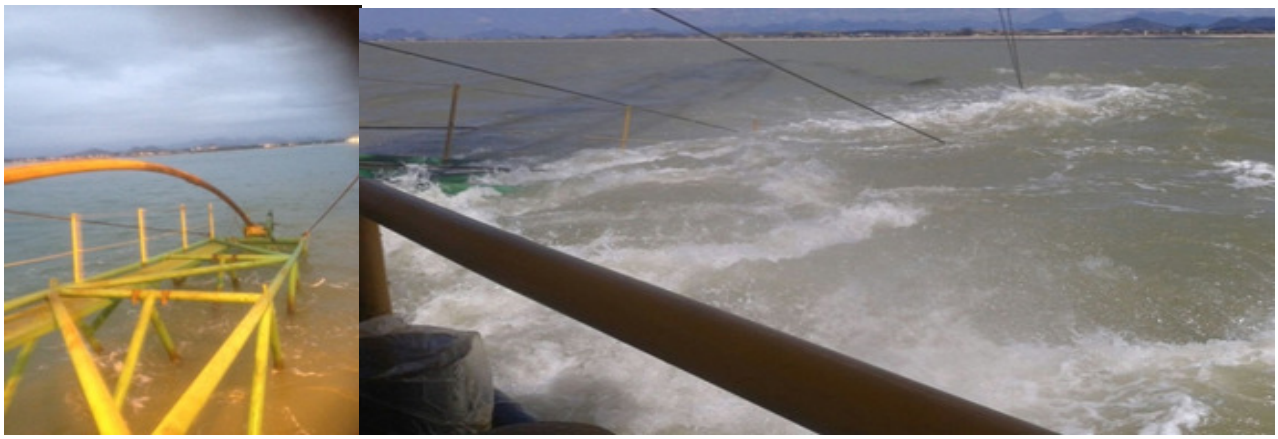
- Partie alluvionnaire sableuse à l'entrée sur 100 m
- Partie rocheuse Gneiss (70-120 Mpa) sur 800 m
- Partie alluvionnaire à la sortie en mer sur 120 m

Les Opérations:

Gaine d'entrée / 20 jours:
La première étape fut l'installation d'une gaine d'acier inclinée de diamètre 44'' pour consolider la partie alluvionnaire à l'entrée du forage. La roche a finalement été trouvée à plus de 200 m du point d'entrée, ce qui a grandement compliqué l'installation de cette gaine d'entrée. Devant l'impossibilité d'installer la gaine jusqu'à la face rocheuse avec les moyens prévus initialement, une gaine télescopique a été mise en place.

Trou pilotes / 1 mois en doubles postes:
La seconde étape fut le forage d'un premier trou pilote. Ce trou pilote incluait une longue courbe horizontale vers la gauche afin de sortir en mer suivant un alignement parallèle aux canalisations existantes dans le corridor attribué à Petrobras par IBAMA.
Un premier forage avec moteur 8'' et tricône 12''1/4 dut être abandonné après 600 mètres du fait d'une faille géologique importante et imprévue ayant généré une déviation non récupérable. Un second trou pilote fut ensuite foré plus profond avec succès.

Alésages / 7 mois en doubles postes:
Du fait du décalage du planning, les alésages ont dû être effectués pendant une période de météo marine très défavorable.



Ces conditions de mer détestables impactaient le mouvement de la barge causant de nombreux dégâts sur les tiges de forage et autres outils. Le résultat fut une perte de 2.5 mois en standby météo et réparations des dommages subis en mer.

Afin de malgré tout poursuivre les travaux, HDI a développé un système de tension constante par contrepoids du câble de treuil sur la barge, et intégré un fusible de sécurité afin que les travaux puissent être réalisés sans mettre en danger le personnel de la barge.

Le fait que le forage ai dû être réalisé à plus grande profondeur, a obligé l'entreprise à forer dans une roche de dureté moyenne très supérieure, avec des mesures d'UCS atteignant 170-

180 MPa, ce qui a également ralenti les cadences d'alésage, augmenté le nombre d'outils nécessaires pour réaliser les travaux et par conséquent augmenté le nombre de trip-out / trip-ins nécessaires aux changements d'outils.

Une grande attention a été consacrée au contrôle de l'usure des outils afin de ne pas risquer de perdre bras ou molette de hole opener dans le trou foré, ce qui aurait généré des opérations de « pêche » très onéreuses et aléatoires, d'autant plus que d'importants moyens offshore étaient mobilisés. En particulier le poids sur outil et le nombre de révolutions des molettes ont été monitorés rigoureusement, les outils étant systématiquement ressortis après 500.000 révolutions. Pour illustrer cela, sur un hole opener de 36'' équipé de molettes 17'' de diamètre, chaque rotation de l'outil représente 2,12 révolutions ; avec une rotation moyenne de 35 tours / minute, on atteint donc les 500.000 révolutions au bout de 112 heures de travail avec face de l'outil au contact.

Les alésages ont été effectués en deux passes de diamètres 28'' et 36'' pour l'essentiel, avec cependant une section de roche extrêmement dure qui a nécessité une passe intermédiaire supplémentaire en diamètre 22''.

Tirage / 1 semaine en double postes:

Une fois le trou de forage intégralement alésé à son diamètre final de 36'', le pipeline fut finalement tiré avec succès à 140 tonnes, après une opération délicate qui consistait à amener la tête de tirage à proximité de la sortie du forage, le tube ayant été déposé plein d'eau en mer à 750 m au-delà du point de sortie. Ce tube étant très lourd du fait de sa forte épaisseur et de sa queue bétonnée de 300 mètre de long, l'opération d'approche a nécessité une procédure particulière, mettant en jeu simultanément l'allégement de la tête de la conduite et de sa queue bétonnée par des « parachutes », et les efforts combinés de traction par la barge (70T vers la surface) et par la foreuse (190T longitudinalement) pour « décoller » la conduite et amener la tête de tirage jusqu'à son entrée dans le trou.

Conclusion:
Travailler au Brésil est loin d'être aussi idyllique que ce que les cartes postales peuvent laisser imaginer! Comme dans nombre de pays désormais, les travaux de pipelines exigent de très nombreuses autorisations en particulier environnementales. Par ailleurs comme pour tout projet d'atterrage, les conditions météo-marines (hauteur de houle, vent, période de la houle, direction de la houle, etc) doivent être évaluées avec soin et des procédures particulières doivent être élaborées pour en tenir compte. Ce projet a été l'occasion pour HDI de faire évoluer ses procédures, en particulier au niveau des travaux d'assistance en mer, afin d'apporter des réponses efficaces au challenge proposé et satisfaire notre client avec la livraison dans les délais d'un ouvrage critique, et ce malgré les complications rencontrées.

Brazilian Sea Turtles
Watching Gneiss HDD

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A New Visual Identity as from December 15th, 2014:

becomes

HDD – Savoir – vivre – in network and pipeline construction

LOCATION:

Some may think that Brasil is only this

THE PROJECT:

Owner:	A Brazilian Company
Main Contractor :	An Italian Company
Contractor / Partner :	INTECH ENGENHARIA
Subcontractors :	HDI = HDD Services
	PENNOIL = Camp
	LOCAR = Offshore Assistance

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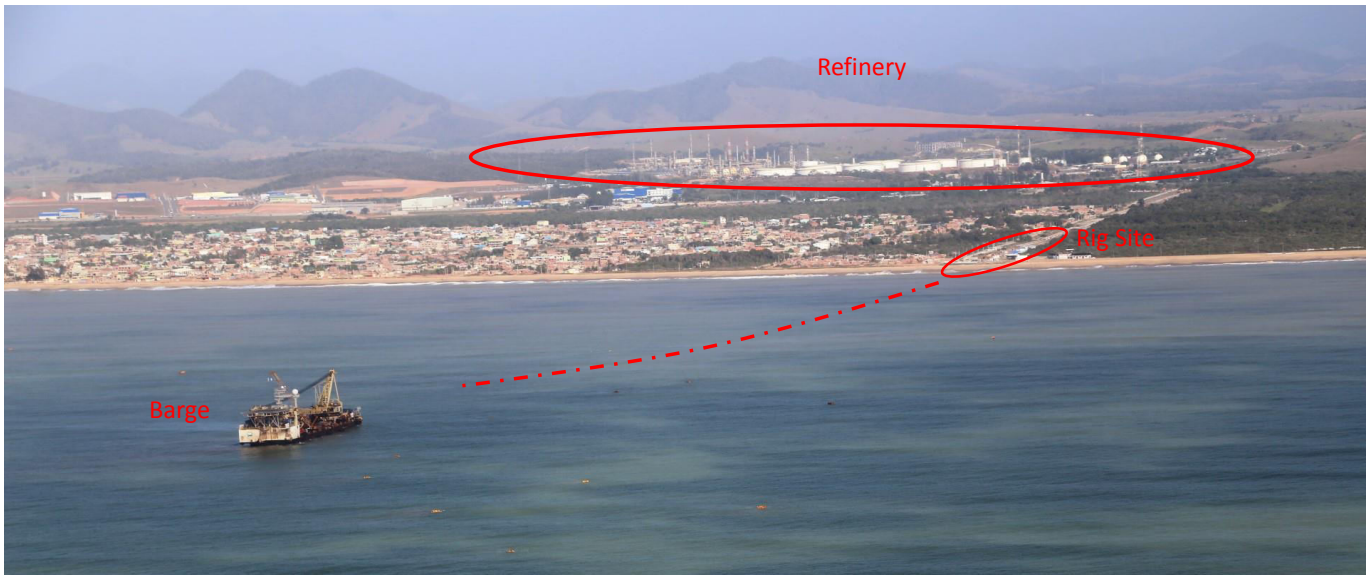
THE DRILLING LOCATION:



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THE DRILLING SPECIFICATIONS:

Drilling	1020 m x Dia 36''
	Combined Horizontal Curve
Gaz Pipeline	1300 m x 24'' Steel Pipeline
	28,3 mm Thickness,
	300 m Concrete Tail (60 mm)
	Pull head laid 750 m behind exit point

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THE GROUND CONDITIONS / CLIENT's INPUTS

Alluvial	100 m Entry
Gneiss UCS 70-120 Mpa	800 m
Alluvial	120 m Exit

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RESOURCES

- HK 400 tons rig
- 1 Recycling PSD 150 & 12
- 2 HP HK pumps & 6 transfert pumps
- 2 Mud Tanks
- 1200 m 6''5/8 FH
- 1300 m 5''1/2 FH
- Taurus Pneumatic Hammer

8 Expatriate
40 Local
(including 20 HSE)

- Barge 60 x 24 m
- 350 tons crane
- 80 tons winch
- Tug Boat

4 Expatriate
10 local
(include 6 HSE)

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LONG START

Difficult start = Postponed > 1,5 year

Project planned January 2013

Environmental Ibama's Licence (Petrobras)
18 months delay
Start May 2014

Reaming during bad metocean conditions (August to December 2014)

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ENTRY CASING

42'' casing to bedrock

Delicate operation because of HSE considerations due to valve station

HSE Stop for Valve station

Bedrock found at 200 m

Decision to install telescopic casing

10 days to install first 100 meters

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PILOT HOLES (= Double Shifts Operations)

Pilot hole n°1	Pilot hole n°2
8'' mud motor & Drill bit 12''1/4	15 m deeper
Geological Fault Deviation	Harder rock
Dog leg = Loss of Pilot at 600 m	23 days
6 days	**Require 22'' Additional Reaming Pass**

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REAMING 22'' & 28''

Poor Metocean Conditions = Heavy Movement of Barge

Swell amplitude = 4/5 m

Drill pipe amplitude on deck = +/- 10 m

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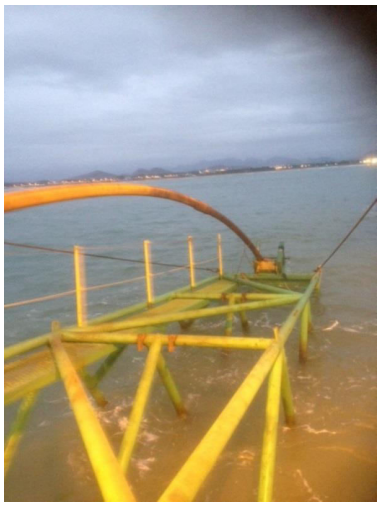
REAMING 22'' & 28''

5''1/2 FH string bent and twisted off



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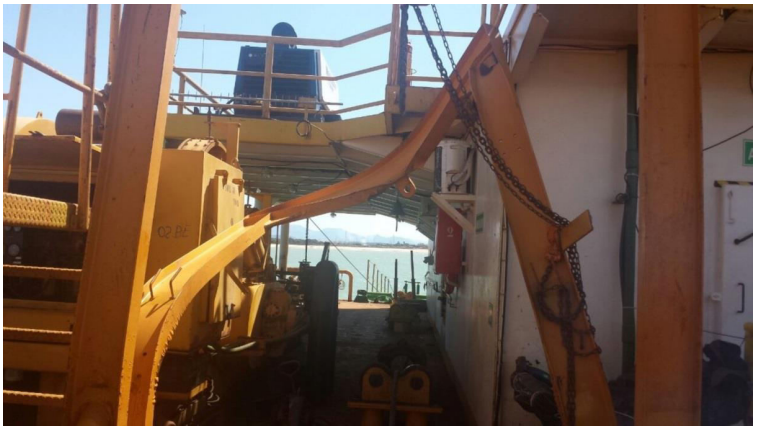
REAMING 22'' & 28''

Failure
of holding structure on barge



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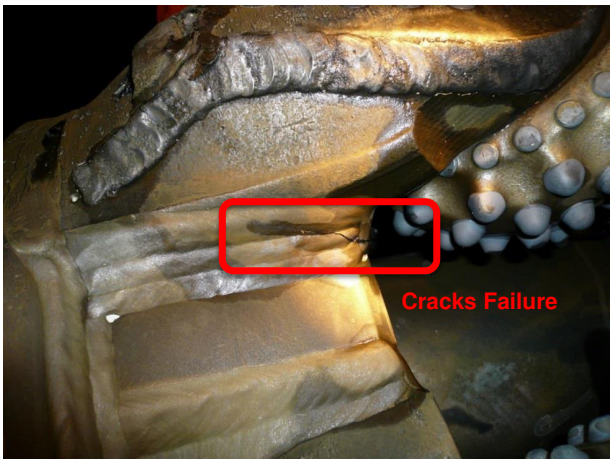
REAMING 22'' & 28''

Failure of HO (43 hours)
Excessive offshore pull



HDI ENTREPOSE
HDD – Savoir – vivre – in network and pipeline construction

REAMING 22'' & 28''

- Impact of Meteocean Conditions

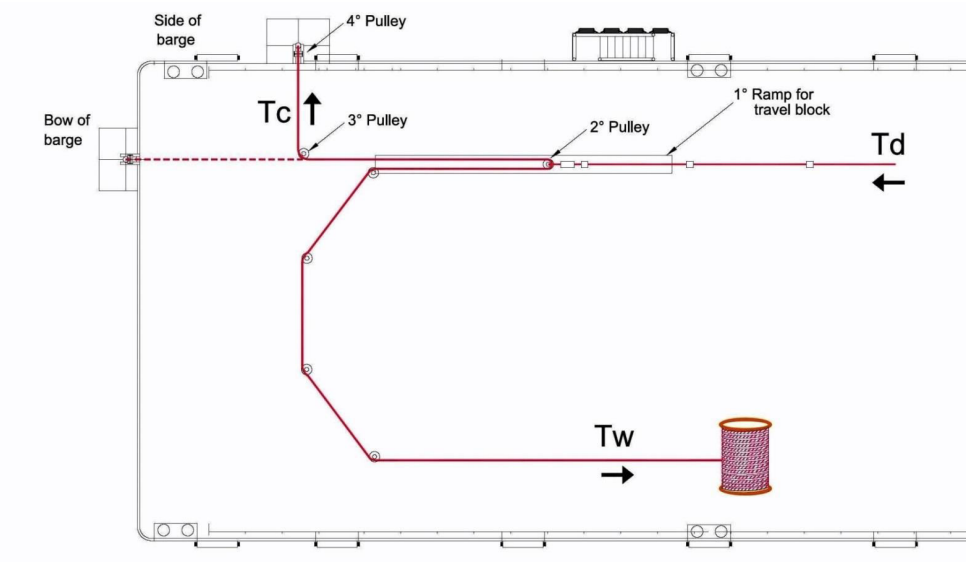
  Safety Issues on the barge

  Standby Weather

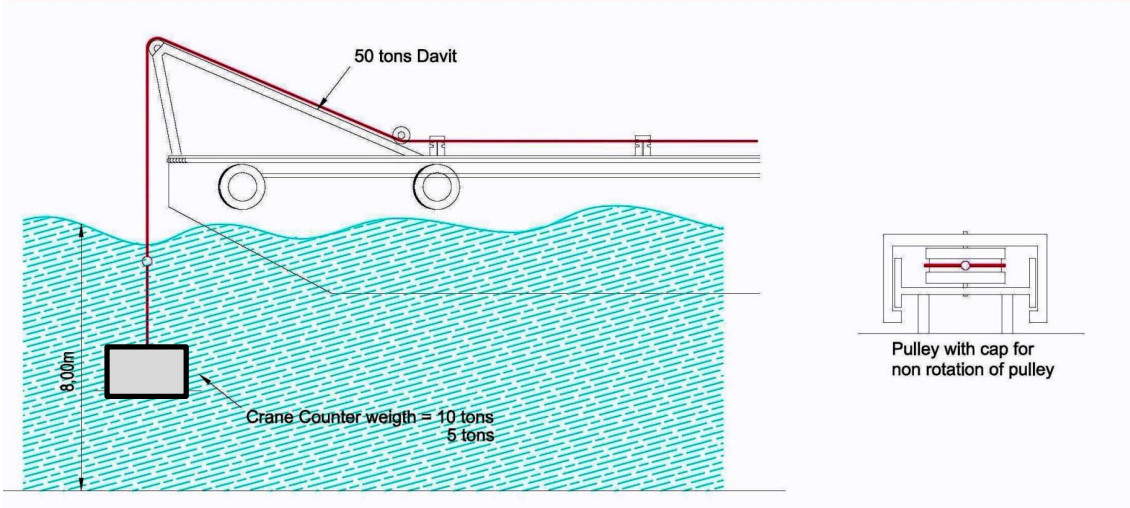
- Alternative solutions

Jack up	NOT AVAILABLE IN BRAZIL
Constant pull winch	CLIENT NOT CONVINCED

DEAD WEIGHT SYSTEM



DEAD WEIGHT SYSTEM



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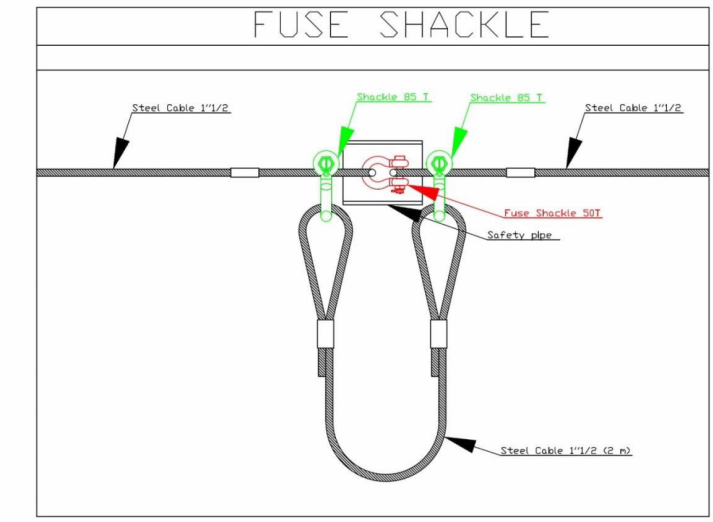
DEAD WEIGHT SYSTEM

HDD – Savoir – vivre – in network and pipeline construction

FUSE SHACKLE



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FUSE SHACKLE

HDD – Savoir – vivre – in network and pipeline construction

SUMMARY OF REAMING SCHEDULE (= Double Shifts Operations)

Reaming 22'' & 28''

- Standby weather = 1 months
- Twist off drill pipe = 0,5 month
- Trip in/out telescopic casing = 1,5 months
- 22'' & 28'' reaming = 2,5 months
- **Sub-total** **= 5,5 months**

Reaming 36''

- 36'' reaming = 1 months
- Trip in/out telescopic casing = 0,5 months
- **Sub-total** **= 1,5 months**

- **Overall** **= 7 months**

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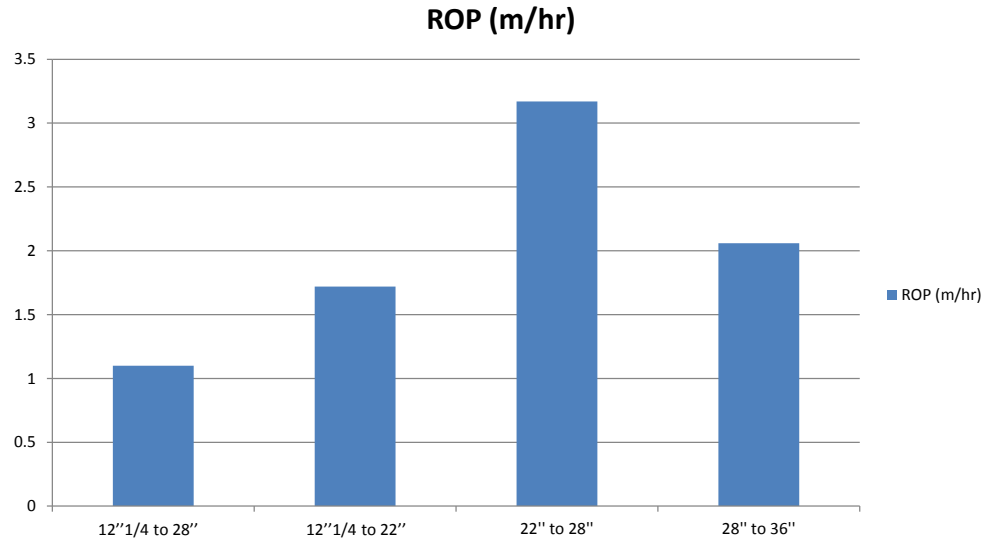
MONITORING OF USE OF HOLE OPENERS

- WOB (Weight On Bits)
  - Vs Number of Cones
  - Vs Offshore pull monitoring
- LIFE TIME (hours)
  - Diameter of HO and Diameter of Cones
  - RPM
  - 500 000 rev Maxi
- HO 28'' = 150 hours (for 20 Rpm) Maxi
- HO 36'' = 120 hours (for 20 Rpm) Maxi

HDD – Savoir – vivre – in network and pipeline construction

PENETRATION RATES



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SWAB & PULL

- Dragging of pipeline from 750 m to exit

  1 week
  Barge + Tug Boat (70 tons)
  Rig (190 tons)
  Air Lift (50 tons with parachutes)

- Pull back (12 hours) = 140 tons

HDD – Savoir – vivre – in network and pipeline construction

GENERAL DATA

- HDD Works = 9 months
- Fuel = 323 000 Liters
- Bentonite = 140 tons
- Water = 8480 cum (dragging = 3000 cum)
- DHT = 2 x HO 22''
  4 x HO 28''
  4 x HO 36''

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Thank you for your attention

HDD – Savoir – vivre – in network and pipeline construction

Pipeline renovation - Vintage pipelines – When to replace a pipeline?

Summary

Pipelines are known for a long and safe life. Ages of around 50 years are no exception and some pipelines have ages of around 100 years. There is no simple rule for replacement of a pipeline. After the design life, many times lifetime extension can be granted based on the results of studies and tests. Aging for the majority of cases is related to corrosion of the pipeline.

The decision to replace a pipeline is determined by one, or a combination of factors:

- Public perception
- Safety or environmental considerations
- Economics

Field joint quality and in controlling external corrosion (field joint) coating and cathodic protection are crucial. Water content, oxygen and inhibitor control are important to limit internal corrosion for exploration pipelines. In oil pipelines flow and scraper operations are important to avoid sludge that is related to the initiation of MIC. Also for such pipelines with a frequently fluctuating pressure, fatigue life is important. For district heating to avoid internal corrosion water quality is crucial.

Insufficient cover will lead to more damage to the pipeline and coating that can go undetected. There are a number of measures to mitigate insufficient cover such as concrete warning tape, concrete plates on top of the pipeline, lowering, up to replacement (esp. water crossings). It is concluded that every pipeline next to its regular inspection and maintenance as laid in the companies procedures, should be independently reviewed by a third party every 15 years.

Jan Spiekhout

Alterung von Rohrleitungen in Europe – Austausch wann?

Zusammenfassung

Rohrleitungen sind bekannt für ein langes und sicheres Leben. Eine Lebensdauer von 50 Jahre für eine Rohrleitung ist keine Ausnahme, sogar einige Rohrleitungen haben ein Alter von etwa 100 Jahren. Es gibt keine einfache Regel für den Austausch einer Rohrleitung. Nach dem Design Lebensdauer kann Lebensdauer Verlängerung gewährt werden, basierend auf den Ergebnissen von Untersuchungen und Tests. Für die meisten Fälle bezieht Alterung sich auf Korrosion die Rohrleitung.

Die Entscheidung, eine Rohrleitung zu ersetzen wird durch eine oder eine Kombination von Faktoren bestimmt:

- Public Perception
- Sicherheit oder Umweltschutz
- Wirtschaft.

Rundnaht Qualität und bei der Überwachung der externen Korrosion sind (Rundnaht) Umhüllung und Kathodenschutz von einer entscheidenden Bedeutung. Für interne Korrosion sind Wassergehalt, Sauerstoff und Inhibitor-Kontrolle sehr wichtig. In Rohrleitungen für Öl sind Durchfluss und Reinigung (Molch) wichtig um Schlamm zu vermeiden der mit MIK zusammen hängt. Die Schwellenfestigkeit ist Wichtig für solche Rohrleitungen mit einer Wechselbelastung von Innendruck. Für Fernwärme ist die Wasserqualität zur Vermeidung interner Korrosion entscheidend.

Zu wenig Überdeckung führt zu mehr Schaden in der Rohrleitung und Beschichtung und die kann unentdeckt bleiben. Es gibt eine Reihe von Maßnahmen auf zu wenig Überdeckung wie z. B. Warnungsstreifen, Beton Platten auf der Rohrleitung, tiefer legen, bis Austausch (z.B.: Wasser Kreuzungen). Wird der Schluss gezogen, dass jede Rohrleitung neben seiner regelmäßigen Inspektion und Wartung gemäß der Firmen-Verfahren, unabhängig überprüft werden soll von einem Dritten jede 15 Jahre.

Jan Spiekhout

Pipeline renovation
Vintage pipelines
When to replace a pipeline?

Jan Spiekhout

DCA – Europe Annual Congress 7-8 October 2015 in Marseille

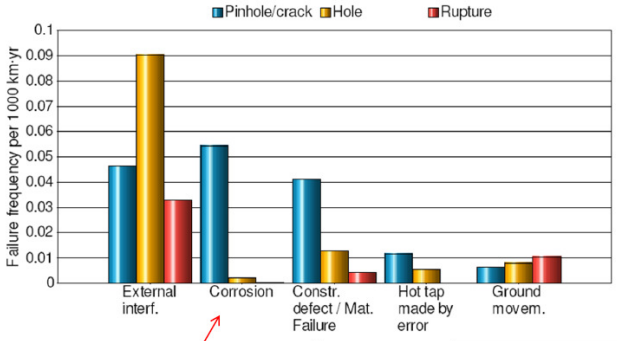
0

Contents

- Pipeline safety statistics
- Causes of aging
- First oil pipelines and town gas
- The 60-ties – Groningen gasfield, oil pipelines connecting refineries
- The 80-ties and 90-ties – first HDD's
- Today
- Example MIC
- District heating
- Overall - Typically
- Most important factors
- Fluctuating pressures
- Pipeline inspection – Pigging, ECDA, leak detection
- Repair
- Replacement examples
- Economics - Repair or replacement?
- Experience
- Conclusions

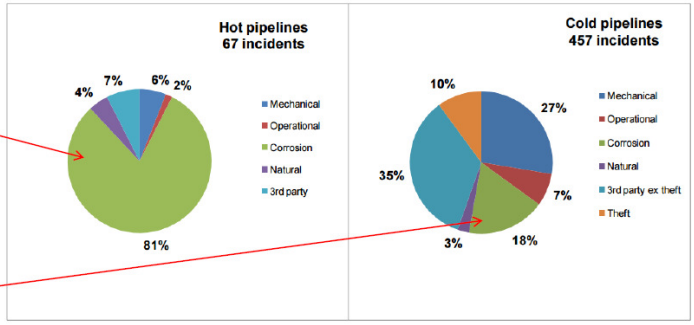
1

Pipeline Safety Statistics



EGIG – Gas pipelines Europe

Concawe – Oil pipelines Europe



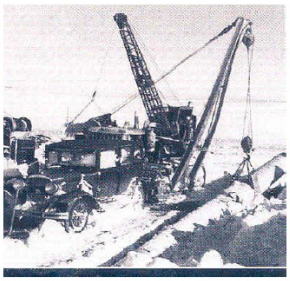
Causes of aging

- External corrosion
- Internal corrosion
- Exotic problems (e.g. stress corrosion, stray currents)
- Insufficient cover (more damage)
- Change of area
- Offshore free span
- Geological phenomena (e.g. landslide)
- Safety related – e.g. grey cast iron (graphite corrosion), first generation PE, old PVC, asbestous cement

First oil pipelines and town gas

Early 1900

Bitumen coating
Coal tar



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The 60 ties – Groningen gasfield, oil pipelines connecting refineries

Bitumen coating

5

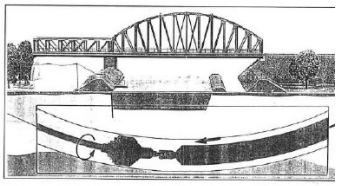
The 80 and 90 ties – first HHD‘s






HORIZONTAL DRILLING

Arbeitskreis zur Weiterentwicklung
und Verbesserung des Horizontal -
Directional - Drilling - Verfahrens

PE coating

Today




PP coating
FBE
……..

Example MIC

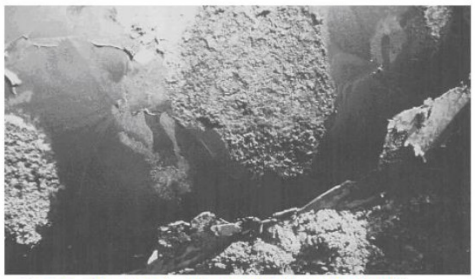


Figure 3.4 – Disbonded pipeline coating associated with external localized MIC. (Source: Peabody's Control of Pipeline Corrosion, 2nd Edition, p. 274. Courtesy Dan Pope, Bioindustrial Technologies, Inc.)

8

District heating

Water quality

9

Overall – Typically (some exceptions)

Town gas period (spanning over 100 years)	Sixties	Other
Steel seamless – e.g. DIN	Diam. 20-36 in.	Exploration (sour, water content)
Some US army surplus pipe	Steel X 56	District heating (water quality)
Grey cast iron	F0 = 0.72	
Bitumen coating, sometimes coal tar	Bitumen coating	
	Construction techniques: Sidebooms, jacking, sinkers	
	No CP in first years	
Ext. corrosion/girth weld quality (also exotic connections)	Steel quality (Charpy-V)?	
Some pipes – material quality problems	Coating – esp. field joint coating (MIC), int. corrosion oil pipelines	

10

Most important factors

- Girth weld quality and (field joint) coating are essential
- Cathodic protection
- Minimum flow
- Water content/oxygen control
- Inhibitors
- Water quality

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Fluctuating pressures

- Dents and fatique

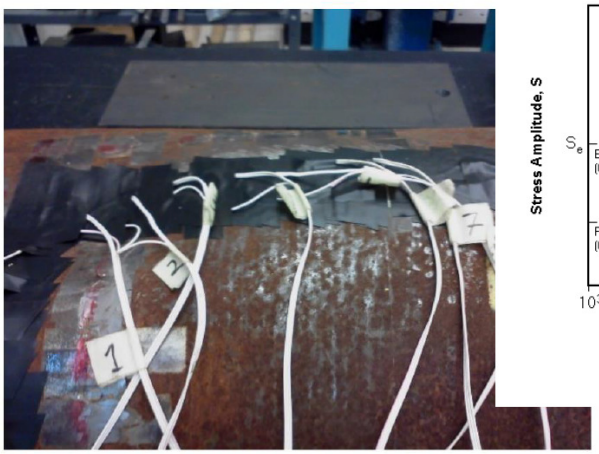


Figure 3.7: Photo of Strain Gauge Locations for Rectangular Indented Pipes

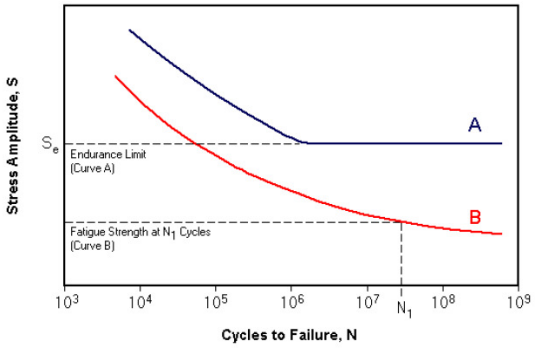
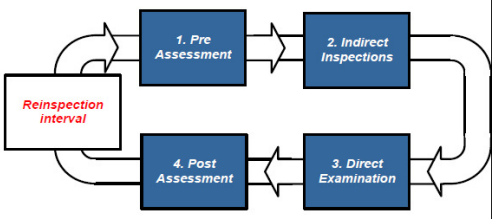


Figure 1: Typical S-N Curves

Pipeline inspection – Pigging, ECDA, leak detection

- Process in four steps acc. NACE
- **RP 0502-2002**

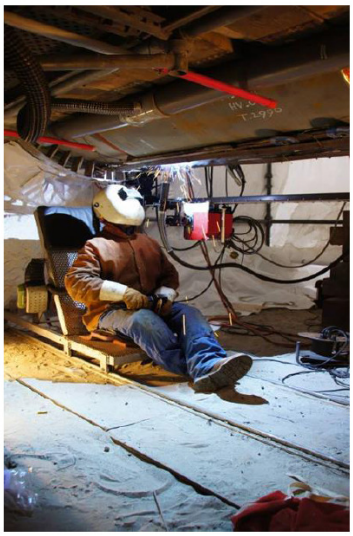


PIMS

Repair

Composite repair (e.g. basis carbon fibre)

Clock Spring



Welded sleeve (welding on in service pipelines

Replacement - examples(1)

NAM-leiding tussen Hardenberg en Coevorden gaat uit de grond

11 juni 2015 | Laatste update: 11 juni, 19:14 2 REAGEER

< Vorige 1 van 2 Volgende >

HOLTHEME - De pijpleidingen van de Nederlandse Aardolie Maatschappij (NAM) rond Hardenberg worden blootgelegd en deels uit elkaar gehaald. De leiding die afvalwater van Schoonebeek naar Twente vervoert is, op acht plekken van binnenuit aangevreten door bacteriën. Het uitgraven van de leiding is vanochtend begonnen, terwijl ondertussen het zoute afvalwater langzaam uit de 70 kilometer lange pijpleiding wordt gedrukt.

Leaks

Exploration – re-injection of associated water – sensitive with public

Longford gas processing and crude oil stabilisation plants

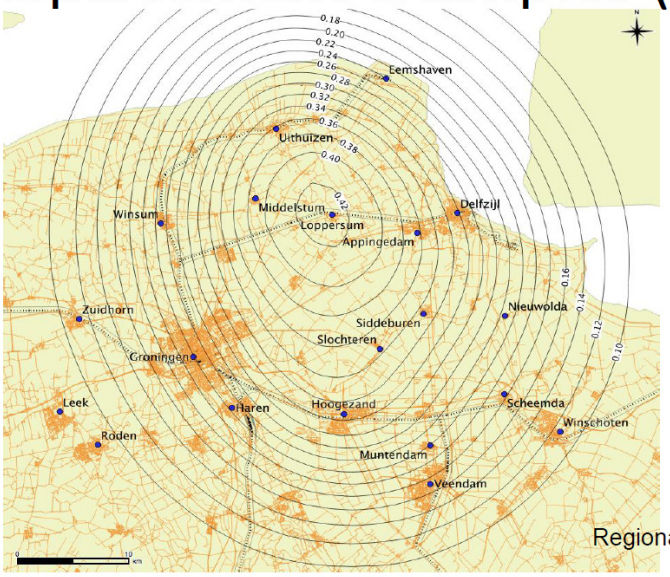
Longford is Esso's onshore receiving point for oil and gas output from Bass Strait. It has been operating for more than 40 years, and has been supplying most of Victoria's gas requirements since 1969. Longford also currently supplies around 20 per cent of Australia's crude oil requirements.

Why is the pipeline being replaced?

The new pipeline will replace the existing 700 mm pipeline, which was constructed in 1969 and underwent a partial replacement in 1980 but is approaching the end of its operational life. This replacement pipeline will not only allow the continued delivery of crude and condensate, but will also be required so that natural gas from Esso's offshore Gippsland operations – which is produced along with these liquids – continues to flow to Australian households and businesses. The new pipeline is expected to be 350 mm in diameter.

Exceeding design life – pressure from public

Replacement examples (2)



Girth weld quality

Regional pipelines before 1964

Induced earthquakes Groningen gas field (Map PGA's 475- rehearsal period)

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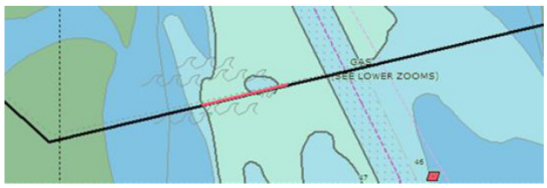
Ems crossing



- The permit requires min. 2m covering
- A part of the pipeline has insufficient cover
- The pipeline does not fulfill the German safety standards
- The German Competent Authorities threatened to block the gas transport
- The German Competent Authorities has asked for a risk evaluation

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Economics – Repair or Replacement ?

Example 100 km 30 in.

- Costs 150 mill. Euro
- Depreciation period 30 years - 5 mill./year
- Pigging every 3 years
- Average 8 repairs/ 3years
- 1000000 + 8×70.000 = 1560000 Euro – 520000 Euro/year

18

Experience

- Weld and coating quality essential
- Control of fluid parameters
- First 15 years no problem
- First “surprises” after 30-35 years

- There is a need for an independent review by an independent party every 15 years

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Conclusion

- When to replace a pipeline is not an easy answer
- Renovation or replacement is driven by: public perception, or safety, or environmental considerations, or economics
- Every 15 years an independent review
- (Field joint) coating and CP are crucial
- Water/oxygen content, inhibitor control and water quality are very important
- Insufficient cover – risk study – number of measures:from protection measures, lowering to replacement (esp. water crossings)

Allt a Chonais – A Highland Hydro HDD

Project	Allt a Chonais Hydro Scheme
Client	Green Highland Renewables (GHR)
Principal Contractor	LMR Drilling UK Ltd (LMR)

Green Highland Renewables specialises in the development of small scale hydroelectric schemes throughout Scotland. These schemes intercept water flowing through mountain streams, diverting some of the flow through a powerhouse where a combination of the head pressure and flow rate of the water turns a turbine which powers a generator thereby producing electricity which is then fed into the grid. The water is supplied to the powerhouse via a pipeline known as a penstock and then, after passing through the powerhouse, the water is returned back to the stream from where it was extracted higher up the valley.

In October 2013 GRH bought the rights for such a scheme from Scottish & Southern Energy (SSE). While steep topography and high rainfall made it an ideal project on paper, the existing design included a 700 m long tunnel drive through a large rock outcrop, the cost of which made the economic viability of the scheme questionable. GRH reconsidered the design of the tunnel and approached HDD contractors to see if that technique provided a more economic but still reliable means of installing the section of penstock through the rock outcrop.

LMR Drilling were awarded the contract to execute the directional drill in March 2014. Here, LMR Drilling Managing Director, Jez Seamans, gives a detailed account of some of the challenges that the HDD encountered and how these were overcome.

Key Project Data:

Location	Strathcarron, Highlands, Scotland
Pipe data	1,000 mm dia. x 58.8 mm wall thickness (SDR 17) PE100
Crossing Length	695 m

Introduction:

The Allt a Chonais Hydro Scheme had the potential to produce 2,000 kW of power at the peak design flow of 1,430 L/s. The water to power the scheme was to be extracted from a large mountain stream with the Gaelic name “Allt a Chonais” from which the scheme derives its name. Water feeds into the Allt a Chonais from a catchment area covering 18 km2 making it a

reliable and powerful water source enabling the proposed hydro scheme to operate close to its maximum potential virtually year-round.

The scheme required the construction of a 2.4 km long penstock running from an intake at an elevation of +250 m AOD to a powerhouse at an elevation of +80 m AOD. The scheme was complicated by an outcrop of rock rising to +285 m AOD between the intake and the power-house. The flat profile of the stream behind the intake and the fact that the stream runs through a deep canyon between the intake and the powerhouse meant that there was no alternative but to install the upper section of the penstock directly through this rock outcrop. This required a c. 700 m long tunnel to be constructed which was redesigned as an HDD to provide the cost be-nefits that made the scheme economically viable.

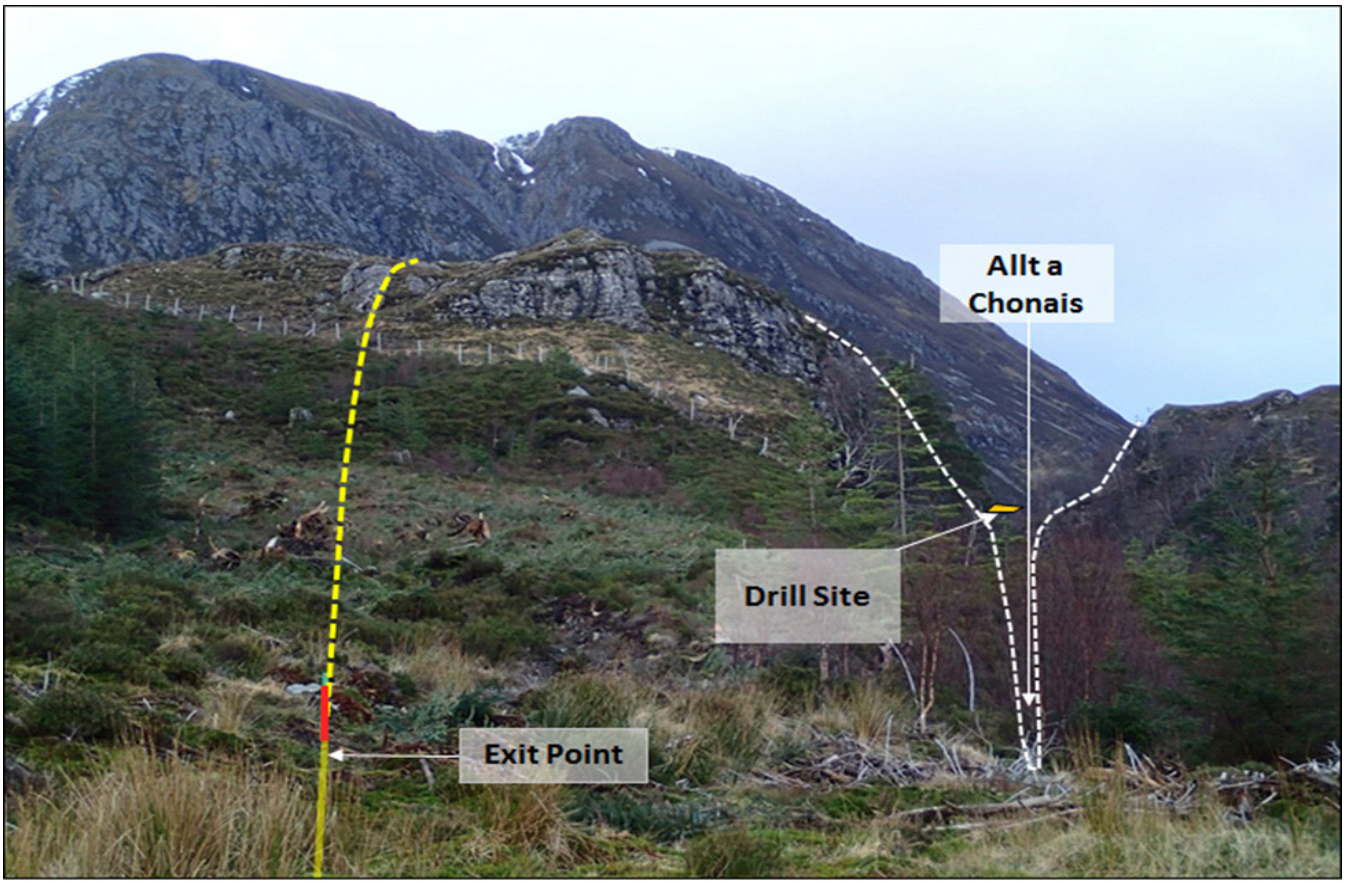

Fig. 1 HDD Alignment from exit point showing extent of the drill

Geology:

The drill was to extend through rock from surface to surface. The rocks of the NW Highlands of Scotland include some of the oldest found on the planet. This was no exception with the rocks through which to drill being a minimum of 800 million years old.

Not surprisingly, therefore, testing of samples from site investigation boreholes indicated that the rocks were very strong (60 – 160 MPa) and very abrasive. The rocks were identified to be highly metamorphosed sediments with interbedded psammites (metamorphosed sandstone that tended to be massively bedded) and pelites (metamorphosed mudstones that tended to be more fractured).

Design:

LMR Drilling were awarded the contract in March 2014 and immediately set about executing the drill design to inform the hydraulic and structural design of the drilled section of the pipeline. These calculations confirmed pre-Contract preliminary calculations that a 1,000 mm OD SDR17 PE100 pipe would be required.

The drill profile had to maintain a continuous fall of at least 2° for the full length of the drill which provided challenges and opportunities. One of the unusual characteristics of such an arrangement was that once the pilot hole drilling had been completed, the hole would drain and contain no drill fluid. As such, hole-cleaning would not rely on the ability of the drill fluid to suspend the rock cuttings and carry them from the hole, rather the hole would be cleaned by way of a river of fluid flowing through the borehole.

LMR decided to establish the drill site at the upper end of the crossing, to drill the pilot hole to punch-out with traditional drilling fluids and then to hole-open in the conventional pulling direction while flushing the hole with high volumes of water rather than drill fluid. The design of the drill profiles and drill fluid processing systems were designed with this approach in mind.

Mobilisation & Pilot Drilling:

The scale of the drilling operations required a maxi-rig spread to be mobilised to site. The nature of the access to the site – along steep forestry tracks necessitated as portable as possible a drill spread to be utilised. Fortunately, LMR have just such a spread with a modular 250T rig which could be delivered to site on standard 40 ft trailers and enabled all offloading to be completed with a 100T mobile crane, the largest that could safely access the drill site.

The drilling equipment start to arrive on 12th May 2014. The equipment was offloaded over three days and the equipment set-up, anchor block cast and assemblies readied for pilot drilling to commence on 22nd May.

Fig. 2 HDD Drill Site showing Drill Alignment

The drill profile dropped a total of 45 m from entry to exit but due to the constrained nature of the site the profile had to be designed with a relatively high entry angle.

In order to be able to comply with the requirement for a minimum 2° fall angle throughout the drill the entry curve had to be designed on a relatively tight radius. In addition, there was a need for the drill design to encompass a horizontal curve through 45° to avoid any risk of drill fluid breakout into the ravine through which ran the Allt a Chonais. With a combined radius of 425 m through the entry curve and with it being absolutely essential to maintain both the horizontal and vertical alignment, it was decided to drill the first 200 m of the pilot hole with a 9⅞" drill bit.

Pilot drilling commenced on 22nd May until, after 37 hours of drilling the 9⅞" hole reached a depth of 240 m on 28th May. This assembly was then withdrawn and replaced with a 16" pilot bit with the remaining components of the drilling assembly uprated to compliment this larger bit size. This assembly reamed the 9⅞" hole up to 16" in 30 hrs before continuing the pilot drilling through virgin ground until reaching the exit point on 2nd June 2014 after a further 123 hrs of drilling. The drill bit exited within 500 mm of the planned exit position and well within the tolerances allowed for within the hydraulic design of the penstock.

Fig. 3 Completion of Pilot Drill

The rate of penetration (ROP) throughout pilot drilling operations averaged a little over 16 minutes per metre which was largely as expected given the strength of the rock. There was relatively little change in rock characteristics noted during pilot-drilling except that the first 100 m was somewhat weaker (with an average ROP of 80 minutes per joint) and this was followed by 20 m of notably weaker rock that was drilled at an average ROP of 50 minutes per joint. Thereafter, the rock was consistently very strong with drill times always exceeding 100 minutes per joint.

Despite the strength of the rock, after 150 hrs of drilling the 16” HDX bit was in excellent condition. While there was some grooving of the legback and flattening of the heel-row inserts, the bearings remained tight and all inserts remained intact and showing relatively little wear.

Hole-Opening

Hole-opening operations were conducted in the standard direction with hole-openers being added to the string at the exit point and the drilling rig pulling the hole-openers up through the hole while rotating. Hole-opening was completed in 3 no. passes of 28”, 38” and 48” diameter. HDX® hole-openers were used throughout.

The fact that the hole was drained of drill fluid meant that the mechanism by which the hole would be cleaned when hole-opening would rely on a high flow rate rather than the ability of the fluid to suspend and transport cuttings.

There were also concerns with respect to the potential for groundwater inflows into the borehole and it was decided, therefore, to use water as the flushing medium during the hole-opening operations so as to be able to dispose of any excess flushing water by way of filtration rather than having to tanker the excess away from site which would have been extremely challenging given the remote site location and difficult access.

28” hole-opening operations commenced on 5th June and progressed relatively well, although the milky nature of the flushing water being discharging from the hole meant that the flushing rate had to be moderated so the water could be pumped back up to the drill site through a pre-installed return line and reused. This process maintained drilling progress but despite the flushing water being passed through a series of silt-buster tanks, the cloudiness of the flushing water remained and eventually, after heavy rains led to a significant increase in groundwater flows into the borehole, there was a need to stop hole-opening operations to allow the silt to settle out of the flushing fluid and to modify the fluid-handling system so as to be able to discharge the excess volumes of fluid over a larger area and mitigate the risk of discoloration of the Allt a Chonais burn into which all of the discharged water inevitably eventually returned.

After a two day hiatus, hole-opening operations recommenced with the 28” hole-opener reaching the entry point on 27th June after 100 hrs of drilling and without any adverse effects on drilling loads due to flushing with reduced volumes of water.

The 28” hole-opener was soon removed at the drill site and replaced with a 38” hole-opener at the exit point and the second hole-opening pass commenced with the minimum of delay. Progress was comparable to the 28” pass, although there was some extremely high rainfall levels that inundated and flooded the intake site on 4th July which greatly increased groundwater inflows into the borehole and continued to frustrate drilling progress while managing the dispersal of the cloudy flushing water from the exit point. Nonetheless, the 38” hole-opening pass was completed on schedule on 7th July with a total drill time for this pass of 92 hrs.

While the ROP was somewhat higher than anticipated, the rate of wear was surprisingly high when compared to the pilot drilling bits. In particular the centralizer ring was exceptionally worn which was attributed to a relatively high volume of cuttings remaining in the hole following the previous pass. Given the high wear and the expectation that the 48” pass would be slower than the previous passes, it was decided to conduct a cleaning run prior to commencement of the final hole-opening pass.

The 38” hole-opener was beyond further use as a hole-opener and the cutters were removed from this tool and the face closed to provide a jetting plate which was run through the hole. This was initially pulled into the hole from the exit site and repeatedly pushed-out to flush cuttings from the bore. Eventually, as it became clear that the cuttings were present throughout the hole, the cleaning push-plate was removed at exit, the drill string withdrawn from the hole and the push-plate run all the way through the hole from the entry point.

Fig. 4 Start of 38” Hole-Opening Pass

After 6 days of cleaning works a total of 45 m3 of large blocky cuttings (approximately 7% of the total volume of the drilled hole) had been flushed and pushed from the hole. These rock fragments were frequently more than 100 mm diameter. While these larger fragments of rock were something of a surprise, the fact that the jetting action of the push-plate had proved effective at removing this material gave confidence that the hole was now clean and that the 48” hole-opening pass could commence.

The 48” hole-opening pass commenced on 15th July and progressed well over the following week with ROPs comparable to those from the previous hole-opening passes until suddenly, and dramatically, the ROP slowed to a crawl (3 - 5 hrs per joint) at 180 - 220 m from the drill entry point. This was something of a surprise given that the tool had been running for less than 70 hrs, but the only course of action was to push the hole-opener back towards exit to see what might be the problem. On reaching the exit side on 27th July, it was clear what the problem was – the tool had lost all cutters and the stabiliser ring!

Recovery Works – Part 1

On a typical HDD, a number of cutters lost down the hole would present a very grave risk of failure to complete the drilling. However, the fact that the hole was free-draining provided a realistic opportunity to flush the cutters from the hole and to then enable hole-opening operations to continue.

While a replacement hole-opener was sourced from INROCK, there was time to undertake cleaning passes. The previously used push-plate was the ideal tool as it could be run through the 38” hole from the drill site and was ‘ready-to-go’.

The push plate was run through the hole from the top site 3 no. times in the process flushing 5 of the 6 no. cutters out of the hole at the exit point.

Fig. 5 48” Hole-Opener – before and after

This left one cutter and the stabiliser ring unaccounted for, but with the 3rd cleaning pass failing to produce either of these missing components and with the replacement XTR hole-opener having arrived on site it had been decided to look to complete the hole-opening before further attempts were taken to recover these pieces. For the following reasons the push hole-opening technique was chosen to complete the 48” hole-opening process:

- The rock was relatively weak near the entry point.
- If hole-opening conventionally, the tooling was likely to be damaged by the missing junk in the hole.
- If hole-opening conventionally, the hole-opener could easily be damaged trying to ream the existing tapering hole.
- With a full-bore 48” diameter hole throughout there would be a better chance to fish successfully.
- The hole had to be enlarged anyway and that would be done by push hole-opening regardless of the success or otherwise of further fishing operations.

A push hole-opening assembly had been designed and a double ring stabiliser also mobilised to site to avoid overstressing the drill string while supplying the required forces to the hole-opener.

These 48” push-hole-opening operations progressed very well with the ROP comparable to that during previous passes with the 180 m of hole remaining to be enlarged completed over 2 shifts and 20 hrs drilling time. A marked increase in ROP on 5th August was indicative that the hole-opener had reached the existing 48” hole and the assembly was withdrawn back to the drill rig.

Surprisingly, there was considerable resistance while extracting the drill string with the hole-opener hanging-up repeatedly during extraction. The reason soon became apparent with the double ring stabiliser having completely disintegrated downhole. This now left some much larger pieces of steel in the hole with the stabiliser rings missing, as well as 3 of the 4 steel plates that formed the blades of the stabiliser.

Fig. 6 Double Ring Stabiliser – before and after

This situation was potentially much more serious. A decision was taken to try to fish for the debris using augers and at the same time to source a means of undertaking a camera survey of the hole to assess the location of the missing components, the condition of the hole and the best means of trying to recover these from the borehole.

Recovery Works – Part 2

Several passes with augers produced the lost stabiliser ring (in one piece) at the drill site and the remaining lost cutter from the lower end of the hole as well as cleaning the hole of further large pieces of rock (up to 200 mm dia.) and preparing the hole for a full length camera survey.

A specialist CCTV survey team arrived on site on 10th August and, with their camera mounted in the end of the drill string, a video survey of the hole was undertaken on 11th. Live pictures from the video camera could be monitored as the camera was pulled through the hole enabling the condition of the hole to be assessed while the survey was undertaken. The first 450 m of the hole was in largely pristine condition with a smooth-bore hole throughout but the upper section of the hole was much more erratic. The survey identified the following:

- 250 m from entry the hole was massively enlarged with a boulder of rock some 500 mm long visible on the video. A rib of stronger rock pushed into the hole showing that the hole-opener had deviated somewhat around this harder formation due to the highly unstable nature of the adjacent rocks. This produced a distinct dog-leg in the borehole at this point.
- The hole tapered and took on a lobed profile from a point 240 m from the entry point. This will have been the point that the hole-opener started to lose its cutters.
- The rock from 160 - 250 m from the entry point was of better quality.
- The rock was much less stable in the upper 140 m of the borehole.
- The missing stabiliser components were sitting in a bed of large cuttings between 90 and 120 m from the drill entry point.

Armed with this information, the decision was taken to enlarge the remaining section of the hole from 180 - 240 m so as to provide a hole through which full-gauge tools could be run from end-to-end. With the knowledge that there was no steel in the borehole from 120 m downwards, it was decided that the only option was to hole-open conventionally. This proved to be successful, with a 700 m long x 48” diameter hole finally completed on 18th August.

While these survey and drilling works had been completed, additional fishing tools in various forms had been prepared and brought to site. The size of the missing plates presented a severe challenge, but fishing operations with a combination of augers and baskets first flushed a lot of the remaining gravel and then eventually recovered all of the missing steel from the hole. The segments of stabiliser ring were successfully pushed through the hole with the cuttings, the stabiliser blades were successfully recovered to the drill site with the baskets.

On 28th August, a clean, 700 m x 48” hole had been realised – the only significant cause for concern now was the profile of the hole at around 250 m from entry and whether the pipe would pass through this section of hole successfully.

Pipeline Construction:

In parallel with the drilling operations, 54 no. 13.4 m lengths of 1,000 mm OD PE pipe were delivered to site, offloaded and transported up to the exit site for butt-fusion welding into a single string.

The stringing site itself dropped by more than 50 m over its length and this severe terrain, coupled with the size of pipe and the narrow stringing site running along the edge of the access road to the exit point, presented many challenges for a pipe string weighing over 120T when fully welded.

Nonetheless, a team of welders and machine operators successfully completed the welding works over a 3 week period with the pulling head welded to the pipe in mid-July. The pipe was prepared on rollers and ready for pullback into the drilled hole when the time came.
:

Pipeline Pullback & Testing:

The pullback operation commenced on 30th August with pulling loads of 50 – 60T for the first 400 m of the pullback. Not surprisingly, the pull and torque increased somewhat as the pulling assembly reached the less smooth section of the hole, but the torque and then pull load increased dramatically when the pulling head reached the dog-leg section of the bore. While it was possible to pass this, the pull load had increased to 190T. It was clear that the resistance was on the pipe and not the reamer and with it being less than clear whether or not the pulling load would increase further after passing this point, it was decided to pull the pipe back out of the hole while that was still possible rather than risk getting the pipe completely jammed in the hole. The pipe was successfully withdrawn and showed little or no sign of any damage.

Fig. 7 Ready for Pullback

A further cleaning/gauging pass was made to help assess whether or not the pull loads were likely to increase still further after passing the 250 m point in the hole. A positive outcome to this led to a second attempt to pull the pipe. Pull loads were similar to the first attempt, increasing to 160T at the 250 m mark, but with a degree of confidence that the pull loads would not increase too markedly beyond this point it was decided to continue with the pullback and, to the relief of all, the pipe installation was successfully completed with a peak pulling load of 230T.

The pipe was subsequently flooded and pressure tested, and, despite the difficulties in verifying the results due to the inclined and non-constrained nature of the pipe, the results of the pressure test proved the integrity of the installed pipe. All that was left was to derig and demobilize the site.

Lessons Learnt:

The main conclusions we have drawn from the HDD operations at Allt a Chonais are:

- When drilling a free-draining hole, flushing with water during hole-opening even at an angle of only 2° is a viable means of providing sufficient hole cleaning to effectively and efficiently enlarge the hole. The one difference we might employ in future operations would be to use a product other than bentonite when pilot drilling to help reduce the cloudiness of the flushing water when hole-opening.
- Double (or single) ring stabilisers of the type used when push hole-opening suffer what we would consider to be a design flaw in that the rings which are wear components are also structural components. Their use in abrasive formations or in aggressive drilling environments cannot be recommended based on our experiences on this drill.

- **Savoir vivre and HDD are not always fully compatible.**

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2	**American Augers, Inc.** 135 US Route 42 44287 OH West Salem, Ohio, USA	**Contact**:Kelly Foss Phone:+1 (419) 8697107 Fax:+1 (419) 8691929 E-Mail: kfoss@americanaugers.com www.americanaugers.com
3	**Atlas Copco MCT GmbH** Langemarckstraße 35 45141 Essen, Germany	**Contact**:Ingo Schwind Phone:+49 (201) 21770 Fax:+49 (201) 2177613 E-Mail: ingo.schwind@de.atlascopco.com www.atlascopco.de
4	**Baroid IDP** Felmicke 46 57462 Olpe, Germany	**Contact**:Ulrich Schröder Phone:+49 (1520) 1541121 Fax: E-Mail: ulrich.schroeder@halliburton.com www.halliburton.com
5	**Berufsförderungswerk des Rohrleitungsbauverbandes GmbH (brbv)** Marienburger Str. 15 50968 Köln, Germany	**Contact**:Dieter Hesselmann Phone:+49 (221) 3766852 Fax:+49 (221) 3766865 E-Mail: heiden@brbv.de www.brbv.de
6	**Bohrmeisterschule Celle** Breite Str.1 C 29221 Celle, Germany	**Contact**:Udo Grossmann Phone:+49 (5141) 991690 Fax:+49 (5141) 99169110 E-Mail: udo.grossmann@bohrmeisterschule.de www.bohrmeisterschule.de
7	**Boretech Holland b.v.** Industrieweg 36 B 2382 NW Zoeterwoude, Netherlands	**Contact**:J.J. Zitman Phone:+31 (7154) 17365 Fax:+31 (7154) 17369 E-Mail: jan@boretech.nl www.boretech.nl
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** Sint Onolfsdijk 39a B9200 Dendermonde, Belgium	**Contact**:Johan Permentier 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**:Rolf Ahlers Phone:+49 (8761) 82378 Fax:+49 (8761) 82665 E-Mail: rolf.ahlers@sud-chemie.com www.sud-chemie.com
12	**Clear Solutions International Ltd** Unit B3 Wem Industrial Estate, Soulton Road, Wem SY4 5SD Shropshire, U.K.	**Contact**:Barrie Townend 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
14	**Deltares** Postbus 177 2600 MH Delft, Netherlands	**Contact**:Henk M.G. Kruse Phone:+31 (88) 3357354 Fax:+31 (88) 3357676 E-Mail: henk.kruse@deltares.nl www.deltares.nl

DCA

Associate Member

15	**Derrick Equipment Company** 15630 Export Plaza Dr. TX 77032 Houston, USA	**Contact**:Ben Clark Phone:+1 (281) 5903003 Fax:+1 (281) 5906187 E-Mail: derrick@derrickequipment.com www.derrickequipment.com
16	**Ditch Witch International - Barcelona** Calle El Pla, 130 08980 Sant Feliu de Llobregat, Spain	**Contact**:Brian Jorgensen Phone:+34 (9363) 27344 Fax:+34 (9363) 27343 E-Mail: bjorgensen@ditchwitch-bcn.com www.ditchwitch.com
17	**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
18	**Dr.-Ing. Veenker Ingenieurgesellschaft mbH** Heiligengeiststraße 19 30173 Hannover, Germany	**Contact**:Jörg Himmerich Phone:+49 (511) 284990 Fax:+49 (511) 2849999 E-Mail: mail@veenkergmbh.de www.veenkergmbh.de
19	**DVGW CERT GmbH** Josef-Wirmer-Str. 1-3 53123 Bonn, Germany	**Contact**:Verena Schrader Phone:+49 (228) 9188812 Fax:+49 (228) 9188899 E-Mail: gassner@dvgw-cert.com www.dvgw-cert.com
20	**ECB GEO PROJECT GmbH** Herbert-Bayer-Strasse 6 13086 Berlin, Germany	**Contact**:Wolfgang Ohm Phone:+49 (30) 4790860 Fax:+49 (30) 47908611 E-Mail: info@ecbgmbh.de www.ecbgmbh.de
21	**egeplast International GmbH** Robert-Bosch-Str. 7 48268 Greven, Germany	**Contact**:Holger Hesse Phone:+49 (2575) 97100 Fax:+49 (2575) 9710269 E-Mail: info@egeplast.de www.egeplast.de
22	**EUROFOR** 55 Rue Ampere BP52 69684 Chassieu Cedex, France	**Contact**:Oliver Nichols Phone:+33 (46674) 6262 Fax:+33 (478) 901995 E-Mail: sales@eurofor.com www.eurofor.com
23	**FLUXYS Belgium S. A.** Avgenue des Arts 31 B-1040 Brüssel, Belgium	**Contact**:Marc Simoen Phone:+32 (2282) 7460 Fax:+32 (2300) 289 E-Mail: Marc.Simoen@fluxys.com www.fluxys.com
24	**FMBE GmbH** Gerwigstr. 4 76437 Rastatt, Germany	**Contact**:Gregor Schütze Phone:+49 (721) 90999500 Fax:+49 (721) 90999509 E-Mail: info@fmb-e.de
25	**FOREXI** FOREXI - BP 364 85403 Lucon Cedex, France	**Contact**:Dominique Feldmann Phone:+33 (555) 113689 Fax:+33 (555) 607264 E-Mail: dfeldmann@forexi.com www.forexi.com
26	**geo-log Ingenieurgesellschaft mbH** Georg-Westermann-Allee 23a 38104 Braunschweig, Germany	**Contact**:Dieter Grundke Phone:+49 (531) 700960 Fax:+49 (531) 7009629 E-Mail: info@geo-log.de www.geo-log.de
27	**GWG Grevenbroich GmbH** Nordstrasse 36 41515 Grevenbroich, Germany	**Contact**:Willi Peitz Phone:+49 (2181) 65058000 Fax:+49 (2181) 65058005 E-Mail: info@gwg-grevenbroich.de www.gwg-grevenbroich.de
28	**Hamburger Stadtentwässerung ein Unternehmen von Hamburg Wasser Ingenieurbüro** Billhorner Deich 2 20539 Hamburg, Germany	**Contact**:Roland Stutzki Phone:+49 (40) 788881633 Fax:+49 (40) 7888181198 E-Mail: roland.stutzki@hamburgwasser.de www.Hamburgwasser.de

29	**Heads Sp. Zo.o.** ul. Piastowska 21 30-065 Krakow, Poland	**Contact**:Krzysztof Czudec Phone:+48 (12) 2690568 Fax:+48 (12) 2692588 E-Mail: heads@heads.com.pl www.heads.com.pl
30	**Hermann Kahnenbley Lohnunternehmen** Overdamm 1 21217 Seevetal, Germany	**Contact**:Hermann Kahnenbley Phone:+49 (40) 7687373 Fax:+49 (40) 7687303 E-Mail: info@kahnenbley.de www.kahnenbley.de
31	**Herrenknecht AG** Schlehenweg 2 77963 Schwanau, Germany	**Contact**:Michael Lubberger Phone:+49 (7824) 3020 Fax:+49 (7824) 3403 E-Mail: lubberger.michael@herrenknecht.de www.herrenknecht.de
32	**Hydro Soil Services** Haven 1025 B-2070 Zwijndrecht, Belgium	**Contact**:Jan Jacobs Phone:+32 (3) 2505311 Fax:+32 (3) 2505651 E-Mail: HSS@dredging.com www.hss.be
33	**IBNi Ingenieurbüro Nickel GmbH** Logebachstr. 4 53604 Bad Honnef, Germany	**Contact**:Werner Limbach Phone:+49 (2224) 97330 Fax:+49 (2224) 973341 E-Mail: Info@ibni.de www.ibni.de
34	**IBZ Neubauer GmbH & Co. KG** Am Waldstadion 3 07937 Zeulenroda - Triebes, Germany	**Contact**:Stefan Heringlake Phone:+49 (36628) 58030 Fax: E-Mail: info@ibz-neubauer.de
35	**Ingenieurbüro Weishaupt** Förstgener Str. 42 04668 Grimma OT Kössern, Germany	**Contact**:Andreas Weishaupt Phone:+49 (172) 3406297 Fax:+49 (3437) 7075011 E-Mail: sekretariat@ib-weishaupt.de www.ib-weishaupt.de
36	**Inrock International LTD** St. Joseph´s Close, Hove BN3 7ES East Sussex, U.K.	**Contact**:David Lewis Phone:+44 (1273) 735500 Fax:+44 (1273) 735511 E-Mail: david@inrock.co.uk www.inrock.com
37	**John Lawrie Tubulars** 15555 Miller Road 1 Houston, TX 77049, USA	**Contact**:Darlene Rodgers Phone:+1 (281) 4567100 Fax:+1 (281) 4567104 E-Mail: corey@jl-mail.com www.jltubulars.com
38	**Kabelwerk Eupen AG** Malmedyerstrasse 9 B-4700 Eupen, Belgium	**Contact**:Marc Emonts Phone:+32 (87) 597700 Fax:+32 (87) 552893 E-Mail: pipes@eupen.com www.eupen.com
39	**MOLL-prd GmbH & Co. KG** **Planungsgesellschaft für Rohrvortrieb und Dükerbau** Weststr.21 57392 Schmallenberg, Germany	**Contact**:Günter Moll Phone:+49 (2972) 978430 Fax:+49 (2972) 9784329 E-Mail: info@moll-prd.com www.moll-prd.com
40	**N.V. Nederlands Gasunie** Postbus 19 9700 MA Groningen, Netherlands	**Contact**:H. J. Brink Phone:+31 (50) 5219111 Fax:+31 (50) 5211999 E-Mail: H.J.Brink@gasunie.nl www.gasunie.nl
41	**NET-TEC** **Dienstleistungen für Netze** Bouche' Straße 12 12435 Berlin, Germany	**Contact**:Frank Heinrich Phone:+49 (30) 857491210 Fax:+49 (30) 857491220 E-Mail: info@net-tec-ingenieure.de www.net-tec-ingenieure.de
42	**Normag** Aengwirderweg 57 8449 BA Terband-Heerenveen, Netherlands	**Contact**:Raymond Petiet Phone:+31 (513) 657209 Fax:+31 (513) 657208 E-Mail: info@normag.nl www.normag.nl

43	**Open Grid Europe GmbH** Kallenbergstr. 5 45141 Essen, Germany	**Contact**:Franz-Josef Kißing Phone:+49 (201) 36420 Fax:+49 (201) 364213900 E-Mail: info@open-grid-europe.com www.open-grid-europe.com
44	**Phrikolat Drilling Specialties GmbH** Reisertstr. 24 53773 Hennef, Germany	**Contact**:Irmhild Lauter Phone:+49 (2242) 933920 Fax:+49 (2242) 9339219 E-Mail: i.lauter@phrikolat.de www.phrikolat.de
45	**Prime Drilling GmbH** Ludwig-Erhard-Str. 4 57482 Wenden, Germany	**Contact**:Werner Wurm Phone:+49 (2762) 930960 Fax:+49 (2762) 93096950 E-Mail: wurm@prime-drilling.de http://www.prime-drilling.de
46	**Prime Horizontal** Salland 3 1948 RE Beverwijk, Netherlands	**Contact**:Simon Kench Phone:+31 (251) 271790 Fax:+31 (251) 271064 E-Mail: office@primehorizontal.com www.primehorizontal.com
47	**Prime-GPT (German Pump Technology) GmbH** Ludwig Erhard Straße 4 57482 Wenden, Germany	**Contact**:Johan Smit Phone:+49 (2762) 986900 Fax:+49 (2762) 98690290 E-Mail: info@prime-gpt.de www.prime-gpt.de
48	**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
49	**ROE** ul. Tuchowska 1/21 30-693 Krakow, Poland	**Contact**:Robert Osikowicz Phone:+48 (601) 717600 Fax:+48 (12) 6548659 E-Mail: roe@robertosikowicz.com www.robertosikowicz.com
50	**Salzgitter Mannesmann Line Pipe GmbH** In der Steinwiese 31 57074 Siegen, Germany	**Contact**:Thorsten Schmidt Phone:+49 (271) 6910 Fax:+49 (271) 691299 E-Mail: info@smlp.eu www.smlp.eu
51	**SiteTec B.V.** Molenvliet 28 3961 MV Wijk bij Duurstede, Netherlands	**Contact**:Alexander de Wagt Phone:+31 (343) 595400 Fax:+31 (343) 595404 E-Mail: adewagt@sitetec.nl www.sitetec.nl
52	**SST Prof. Dr.-Ing. Stoll & Partner Ingenieurgesellschaft mbH** Charlottenburger Allee 39 52068 Aachen, Germany	**Contact**:Fritz Schwarzkopp Phone:+49 (241) 160000 Fax:+49 (241) 1600016 E-Mail: f.schwarzkopp@sst-consult.de www.sst-consult.de
53	**Stadtwerke Düsseldorf Netz GmbH** Höherweg 200 40233 Düsseldorf, Germany	**Contact**:Martin Tank Phone:+49 (211) 8212159 Fax:+49 (211) 821776389 E-Mail: info@swd-netz.de www.swd-netz.de
54	**Steffel KKS GmbH** Im Bulloh 6 29331 Lachendorf, Germany	**Contact**:Daniel Steller Phone:+49 (5145) 9891200 Fax:+49 (5145) 9891290 E-Mail: kks@steffel.com www.steffel.com
55	**Step Oiltools GmbH** Bockhorner Weg 6 29683 Bad Fallingbostel, Germany	**Contact**:Jürgen Muhl Phone:+49 (5162) 98580 Fax:+49 (5162) 985821 E-Mail: Juergenmuhl@stepoiltools.com www.stepoiltools.com
56	**STÜWA Konrad Stükerjürgen GmbH** Hemmersweg 80 33397 Rietberg, Germany	**Contact**:Ralph Stükerjürgen Phone:+49 (5244) 4070 Fax:+49 (5244) 1670 E-Mail: info@stuekerjuergen-konrad.de www.stuewa.de

57	**TAU Ingenieurgesellschaft mbH Beratende Ingenieure und Geologen** Helmholzstr. 2-9 10587 Berlin, Germany	**Contact**:Norbert Landesberger Phone:+49 (30) 3997770 Fax:+49 (30) 39977729 E-Mail: n.landesberger@tau-ingenieure.de www.tau-ingenieure.de
58	**TDC Technical Duroplastic Constructions GmbH** Gewerbepark 8 17039 Trollenhagen, Germany	**Contact**:Gerd Paulisch Phone:+49 (395) 4290618 Fax:+49 (395) 4290619 E-Mail: info@tdc.de www.tdc.de
59	**Tiger Trading, Inc.** 13618 Poplar Circle, Ste 301 77304 Conroe, Texas, USA	**Contact**:Thorn Huffman Phone:+1 (936) 4418877 Fax:+1 (936) 5215130 E-Mail: thorn@tigertrading.net www.tigertrading.net
60	**Tracto-Technik GmbH & Co. KG** Paul-Schmidt-Str. 2 57368 Lennestadt, Germany	**Contact**:Meinolf Rameil Phone:+49 (2723) 8080 Fax:+49 (2723) 808180 E-Mail: meinolf.rameil@tracto-technik.de www.tracto-technik.de
61	**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
62	**Vermeer** Nijverheidsstraat 20 4458 AV 's-Heer Arendskerke, Netherlands	**Contact**:P. Vergouwe Phone:+31 (113) 272700 Fax:+31 (113) 272727 E-Mail: cvandendries@vermeer.com www.vermeer.com
63	**Vermeer Deutschland GmbH** Puscherstr. 9 90411 Nürnberg, Germany	**Contact**:Franz Kissling Phone:+49 (911) 540140 Fax:+49 (911) 5401499 E-Mail: info@vermeer.de www.vermeer.de
64	**Westnetz GmbH** Florianstr. 15-21 44139 Dortmund, Germany	**Contact**:Stephan Birtner Phone:+49 (231) 4382403 Fax:+49 (231) 4383010 E-Mail: stephan.birtner@rwe.com www.rwe.com

Extraordinary and Honorary Members

Extraordinary Members:

Rohrleitungsbauverband (rbv)
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50968 Köln, Germany

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Phone:+49 (221) 3766852
Fax:+49 (221) 3766865
E-Mail: hesselmann@rbv.de
www.rbv.de

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 return the completed application form back to our office. The board will decide on admission in each individual case (see scale of fees).

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

☐ **HDD-Company (regular):**

- Number of HDD drilling rigs: ____ Sum of pulling forces: _____ KN

- two reference letters of clients
- Information to the Quality management system
- 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, engeneering companies etc. (associated):**

- number of persons employed in the company _____

- Information to the Quality management system
- 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 juridical person who is willing to promote the target of the association can become 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 juridical or natural persons who professionally execute horizontal directional drillings with their own equipment. Associate members are juridical or natural persons who are willing to promote the target 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. Among regular and associate members there are no differences in obligations and rights.

Fixing of membership fees

Drilling Companies (regular):

The fixing of the membership fee for drilling companies takes place 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 application the board decides on the final classification into the contribution group. Any changes have to be reported to the DCA executive committee immediately, however until the next members meeting in the following financial year at the latest. The fee is then adapted accordingly.

Group 1: Sum of all pulling forces	≤ 1,000 KN	1,000.00 €
Group 2: Sum of all pulling forces	> 1,000 ≤ 2,500 KN	2,000.00 €
Group 3: Sum of all pulling forces	> 2,500 KN	3,000.00 €

Supplier Companies, Clients, Consulting Companies, Clients, etc. (associate):

The fixing of the membership fee of associate members is calculated on the basis of the number of persons employed in the company, whereby 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 the board decides on the final classification into the contribution group. Any changes have to be reported to the DCA executive committee immediately, however until the next members meeting in the following financial year at the latest. The fee is then adapted accordingly.

Group 1: Number of employees	< 5	800.00 €
Group 2: Number of employees	5 ≤ 50	1,000.00 €
Group 3: Number of employees	50 ≤ 200	1,250.00 €
Group 4: Number of employees	> 200	1,500.00 €

For further information please contact us at our office in Aachen (++49 (0)241-9019290) or visit our homepage **www.dca-europe.org**.

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)
Dipl.-Geol. D. Quante
52068 Aachen - Charlottenburger Allee 39
Tel.: 0241-9019 290; Fax -299; eMail: d.quante@dca-europe.org
Web: www.dca-europe.org

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	1.000,00 €
Gruppe 2: Summe aller Zugkräfte	> 1000 ≤ 2.500 KN	2.000,00 €
Gruppe 3: Summe aller Zugkräfte	> 2.500 KN	3.000,00 €

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	800,00 €
Gruppe 2: Anzahl Beschäftigte	5 ≤ 50	1.000,00 €
Gruppe 3: Anzahl Beschäftigte	> 50 ≤ 200	1.250,00 €
Gruppe 4: Anzahl Beschäftigte	> 200	1.500,00 €

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.