

HOME PAGE INFORMATION

ABOUT ENIKKOM GROUP

Innovative Solutions and Top of the line service

ENIKKOM is an industry-leader in engineering, procurement, fabrication, construction and installation services, providing end-to-end project management capacity offering full range Engineering, Procurement, Construction, Installation & Management (EPCI-M) to the oil and natural gas industries.

As a group, we leverage our network of companies and experience to provide our customers with the nation's largest pool of skilled workers, equipment and specialized services to deliver EPCI-M solutions across the Nation. [\(About Us\)](#)

OUR CAPABILITIES

Trenchless Installations

Our Horizontal Directional Drilling (HDD) and Direct Pipe (DP) services provide safe, trenchless solutions to accurately and efficiently install underground pipelines and utilities across roads, railways, rivers and other obstacles. With experienced professionals, modern equipment, and innovative solutions, We successfully deliver safe, economical and environmental friendly projects and services that benefit our clients, their customers and our surrounding communities. [\(see more\)](#)

Flowline / Pipeline Construction Maintenance

We provide comprehensive pipeline and facility infrastructure construction, fabrication, replacements, repairs, and maintenance services to pipeline and facility owners throughout the Nation. We successfully delivery irrespective of the terrain, Land, Swamp, Offshore Flowlines and facilities. [\(see more\)](#)

Dredging and Piling Works

We provide dredging and piling solution and operate some of the most modern and versatile dredging fleets in the industry, with equipment in every size and segment, giving our clients flexible solutions for Sand Filling, Reclamation Works. We provide professional and innovative dredge services particularly in the difficult swamps of the Nation. [\(see more\)](#)

Production Facilities Construction and Operations

We provide fit-for-purpose, integrated production systems for maximizing recovery, accelerating production, managing risk, and improving project economics. Our services are designed to international standards, are equipped with leading process technologies that connect subsurface and surface expertise from design through operations. With these technologies, domain expertise, and a digital

environment, we conduct multidisciplinary projects that integrate characterization for optimizing facility design and operations across the life of the field. . (see more)

Pipeline Security & Monitoring

Solutions focused on strength of research and development; our innovation tailored to the specific need to combat pipeline vandalism. We are capable of monitoring and detecting tampering on pipelines in real time. (see more)

OUR COMMITMENT

SAFETY

An inseparable part of our organizational culture

Safety is fundamental and non-negotiable, and it must guide all of our actions and commitments. Our safety culture encompasses the behaviors, beliefs, and values that all of the people at our Company share as a way of controlling the risks present in our activities.

Our aim is to pursue our "zero accidents" goal, and we focus on facilities, processes, and people to achieve it. Prevention, incident analysis, communication, and improvement measures help us to control and manage risks.

QUALITY

Our Quality Management System (QMS) ensures we deliver quality services and products to clients and partners and is the backbone of our operations as a company. recognizes the responsibility of all employees to foster a culture that is consistent with standards of quality and conforms to customer and company requirements. We are committed to continually getting better in all areas, with the responsible use of technology and industry-leading programs

COMMUNITY

We believe strongly in giving back and being good community citizens. Social responsibility is not a buzzword for us; it's how we do business. We strive to be a model business and contribute positively toward improving the communities we live and work Our community involvement initiatives span our entire geographic footprint and allow our people to give back in meaningful ways.

ENVIRONMENT

We are committed to sustainable development through environmental protection.

We are dedicated to meeting the needs of our society today and to minimizing the impact of our actions on future generations and on the environment.

We recognize our responsibility to — and the importance of — being a responsible steward of the environment

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1.1 COMPANY OVERVIEW

1.1 COMPANY OVERVIEW

Company Overview

Enikkom Group is a leading engineering, procurement, fabrication, construction, and installation (EPCI) company, providing end-to-end project management and support services for onshore and offshore flowlines, pipelines, and facilities. Leveraging decades of industry experience, we deliver precise, innovative, and sustainable technical solutions across Nigeria.

As a wholly owned subsidiary of **Enikkom Investment Services Nigeria Limited (EISNL)**, established in 1995, Enikkom Group draws from a rich pool of highly skilled professionals, modern equipment, and tailored services to deliver bespoke infrastructure solutions nationwide. Our resilience, technical depth, and commitment to excellence distinguish us as a trusted partner in Nigeria's oil and gas sector.

Enikkom Construction Limited (ECL)

Incorporated in **March 2009**, **Enikkom Construction Limited (ECL)** was established to focus exclusively on **pipeline construction and associated infrastructure works**. **ECL** was established as a result of the realization of the huge opportunities which the pipeline construction business presents in Nigeria and the need to setup a dedicated company for the purpose of exploiting these opportunities.

As a fully indigenous company, ECL harnesses the expertise of highly skilled engineers, technicians, and project managers to deliver **end-to-end EPC services**. The company is also recognized as a pioneer in **Horizontal Directional Drilling (HDD)** in Nigeria, completing the **first HDD crossing of the River Niger in 2003**.

HDDThailand – Enikkom Limited

To further strengthen its HDD and trenchless technology capacity, ECL partnered with **HDDThailand Co. Ltd**, a global leader in trenchless solutions with over **15 years of international experience**. This collaboration gave rise to **HDDThailand–Enikkom Limited**, a specialist infrastructure company focused on advanced **HDD and pipeline construction services**.

Through this partnership, the company combines **over 22 years of Nigerian HDD experience** (via ECL) with **global best practices and innovations from HDDThailand**, delivering world-class trenchless technology solutions to the oil and gas industry.

Our core capabilities include:

- Pipeline Construction (Land, Swamp and Offshore)
- Horizontal Directional Drilling - HDD for rivers, roads, swamps, rail lines, and urban crossings
- Horizontal Directional Drilling - Thrust Boring
- Steel and Metal Fabrication (Storage Tanks, Process works)
- Dredging Works
- Geotechnical Survey
- Equipment Leasing

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- Civil Construction (Piling, Jetty, Bridges etc)

ENIKKOM is the pioneer and leading Horizontal Directional Drilling (HDD) contractor in Nigeria, with the largest fleet of Horizontal Directional Drilling rigs in Nigeria – 7 (No's maxi HDD Rig), 3 (No's mini-HDD Rig), 4(No's Micro-tunnelling and Pipe Jacking Machines) and 6 (No's Pipe Thrust Boring Machine). The following are some of our Maxi equipment in country:

HDD Rigs:

- 500 Ton HDD Drilling Rigs (500 Ton Pullback Capacity) - 2 Nos
- 300 Ton HDD Drilling Rigs (300 Ton Pullback Capacity) - 3Nos
- 200 Ton HDD Drilling Rigs (200 Tons Pullback Capacity) - 2Nos
- 150 Ton HDD Drilling Rig (150 Tons Pull Back Capacity) - 1Nos
- 100 Ton HDD Drilling Rig (100 Tons Pull Back Capacity) - 1Nos
- 50 Ton HDD Drilling Rig (50 Tons Pull Back Capacity) - 1Nos

Micro Tunneling & Pipe Jacking Equipment:

- 48" Micro Tunnelling Equipment and accessories - MTS - 1Nos
- 800 Ton Pipe Pusher - TSG - 1nos
- 750 Tons Herrenknecht Thruster - 1Nos
- 380 Ton Pipe Pusher – Prime Drilling - 1Nos

Thrust Boring Machines:

- 72–1200 NG Thrust Boring Machine - 1Nos
- 48/54–G900 Thrust Boring Machine - 1Nos
- 42"/48" – G600 Thrust Boring Machine - 1Nos
- 36"/42" - 600 Pounds Push Capacity - 1Nos
- 36 “– 340 Pounds Thrust Boring Machine - 1Nos
- 24 - 100 Thrust Boring Machine - 1Nos

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Our project portfolio reflects our unwavering dedication to achieving client objectives meeting targets efficiently and effectively, while upholding industry best practices and safety standards. {{Link to Project Portfolio}}}

Track Record & Achievements

- Pioneers of HDD in Nigeria since 2003, with **10 HDD rigs and counting**.
- Successfully completed **over 100km of HDD installations** within the last 16 years, covering diameters from 4" to 40" and lengths ranging from 50m to 3.1km in a single drill.
- Holder of multiple **African HDD records**, including:
 - **Longest single drill:** 3.1km x 16" (Arepo/Imagbon line on the Atlas Cove–Mosimi Pipeline, April 2016).
 - **Deepest HDD crossing:** 36" x 1.2km Ekiadalor Deep Valley Crossing at over 80m depth (February 2016).
- 40" X 760M LONG RIVER/ROAD FISH POND CROSSING USING HDD FOR DAEWOO/SPDC. Line was successfully completed in January 2010 and was buried at a depth of 100ft. Pipe wall thickness is 1". *****THIS IS THE LARGEST PIPELINE SIZE CROSSING IN NIGERIA AT THE TIME OF COMPLETION*****
- SPDC OTUMARA-ESCRAVOS PIPELINE PROJECT, HDD FOR ESCRAVOS RIVER CROSSING for SAIPEM CONTRACTING NIGERIA LIMITED / SPDC which involved the following: Mobilizing of 2nos. HDD Rigs (300Tons) Plus (500Tons) to Site; Site Set Up; Installation of 12" + 3" x 2.78km Long Bundled Crossing Using the Intersect Method whereby the Crossing was Drilled from Both Ends Using Two (2) Rigs and Intersecting at the Middle for the Pilot Hole *****THIS IS THE LONGEST BUNDLED CROSSING IN AFRICA AT THE TIME OF COMPLETION*****
- More recently, in collaboration with our partners have made some breakthrough in long-reach (extended) crossings achieving successful HDD laying of pipelines beyond 3.0km which was the threshold of previous widths achievable. Our HDD crew and equipment have just completed the installation of Pipeline Crossings by CONTINUOUS HORIZONTAL DIRECTIONAL DRILLING (CHDD) for NPDC which involved the laying of 12inch x 10km Pipeline by CHDD in Utorogun, Warri, Delta State. *****THIS IS THE LONGEST FUNCTIONAL CONTINUOUS HDD CROSSING IN NIGERIA AT THE TIME OF COMPLETION*****
 -

Why Enikkom?

- Over **25 years of industry experience** through the Enikkom Group.
- Proven **technical capacity** and innovative HDD expertise unmatched in Nigeria.
- Indigenous company with **deep local knowledge** and international partnerships.
- A consistent record of **delivering complex projects** safely, on time, and to specification.

1.1.1 Elite Infrastructure Solutions. World-Class Delivery.

Enikkom Group is an industry-leader in engineering, procurement, fabrication, construction and installation services, providing end-to-end project management capacity and support services for numerous off- and onshore flow lines, pipelines, and end facilities.

Pioneers of the Horizontal Directional Drilling (HDD) method, we leverage our vast experience in the field to deliver precise technical solutions. As a wholly owned subsidiary of Enikkom Investment Services Nigeria Limited (est. 1995) we elicit from the nation's top pool of skilled staff, equipment, and tailored services to deliver bespoke infrastructure solutions across Nigeria.

Resilience remains our watchword, and sets us apart from the competition. Our project portfolio highlights our commitment to meeting client goals, utilising every tool at our disposal to accomplish outlined goals in a timely manner.

1.2 OUR SERVICES & WHAT WE DO

1.2.1 Second Way of Listing What We Do (Let MD Choose the One He Wants)

Project Management / Consultancy Services

Complete project ideation, management and support. Supervision over project and materials control, inspection, commissioning, start up and construction, on-demand to the client.

Trenchless Installations

Our Horizontal Directional Drilling (HDD) and Direct Pipe (DP) services provide safe, trenchless solutions to accurately and efficiently install underground pipelines and utilities across roads, railways, rivers and other obstacles. With experienced professionals, modern equipment, and innovative solutions, We successfully deliver safe, economical and environmental friendly projects and services that benefit our clients, their customers and our surrounding communities.

- Horizontal Directional Drilling Services (HDD) – one sentence descriptor.
- Guided Boring (Thrust Boring) – one sentence descriptor.
- Micro Tunnelling – Slurry Spoil Removal System – one sentence descriptor.
- Direct PIPE Technology – one sentence descriptor.
- Horizontal Boring (Hole Hog) – one sentence descriptor.
- Pipe Ramming (Casing Installation) – one sentence descriptor.
- HDD Rescue – one sentence descriptor.
- Pneumatic Pipe Bursting – one sentence descriptor.
- Static/Hydraulic Pipe Bursting – one sentence descriptor.

Flowline / Pipeline Construction Maintenance

We provide comprehensive pipeline and facility infrastructure construction, fabrication, replacements, repairs, and maintenance services to pipeline and facility owners throughout the Nation. We successfully delivery irrespective of the terrain, Land, Swamp, Offshore Flowlines and facilities.

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Dredging and Piling Works

We provide dredging and piling solution and operate some of the most modern and versatile dredging fleets in the industry, with equipment in every size and segment, giving our clients flexible solutions for Sand Filling, Reclamation Works. We provide professional and innovative dredge services particularly in the difficult swamps of the Nation.

Production Facilities Construction and Operations

We provide fit-for-purpose, integrated production systems for maximizing recovery, accelerating production, managing risk, and improving project economics. Our services are designed to international standards, are equipped with leading process technologies that connect subsurface and surface expertise from design through operations. With these technologies, domain expertise, and a digital environment, we conduct multidisciplinary projects that integrate characterization for optimizing facility design and operations across the life of the field.

Pipeline Security & Monitoring

Solutions focused on strength of research and development; our innovation tailored to the specific need to combat pipeline vandalism. We are capable of monitoring and detecting tampering on pipelines in real time.

Logistics Support Services

Support for land and swamp logistics, employing low bed trailers, self-loaders, low loaders, and pickup trucks for the former and flatbed/ramp barges, crew boats, and supply vessels for the latter.

1.3 ENIKKOM GROUP & PARTNERS

1.3.1 Enikkom Investment Services Nigeria Limited (EISNL)

ENIKKOM Investment Services Nigeria Limited (**EISNL**) is a wholly indigenous company that was incorporated in 1995 to handle special investment portfolio in the different sub-sectors of the economy, like the engineering and construction sector, the dredging and piling sector, the energy and oil & gas sector and the transportation and haulage **sectors**.

1.3.2 Enikkom Construction Limited (ECL)

As a result of the growth and expansion of EISNL oil and gas portfolio and in order to synergize the services which EISNL offer, ENIKKOM CONSTRUCTION LIMITED (ECL) was incorporated on the 23rd day of March 2009 to specifically handle the Pipeline Construction (Land & Swamp, Offshore, Horizontal Directional Drilling-HDD, Horizontal Drilling-Thrust Boring), Steel and Metal Fabrication (Storage Tanks, Process Works), Dredging works, Civil Construction (Piling, Jetty, Bridges), contract portfolio of her parent company, Enikkom Investment Services Nigeria Limited (EISNL) – A highly diversified Engineering Services Company established in 1995.

ECL was established as a result of the realization of the huge opportunities which the pipeline construction business presents in Nigeria and the need to setup a dedicated company for the purpose of exploiting these opportunities.

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At inception, **ECL** was owned 95% by her parent company EISNL. However, following a need to inject fresh managerial capacity, free up the company from the challenges of her parent company and strengthen her to harness the expected massive growth in business, a team of experienced and knowledgeable investors “The E-Place Limited” in January 2013 acquired the interest of EISNL in ECL.

ECL is a wholly Nigerian indigenous company that pools the expertise of very experienced engineers, technicians and personnel to provide services within the oil and gas industry. ENIKKOM’s strength is in the depth and breadth of her Construction, CASHES and Project Management Technology which covers key projects on land and swamp.

ECL the leader and pioneer HDD contractor in Nigeria (Since 2003, 10, Rigs and counting) We have completed over 100km of HDD installations over the last 16 years from 4” to 40” in pipe size diameter and length ranging from 50m to 3.1km single drill. As pioneers of Horizontal Directional Drilling (HDD) in Nigeria, ECL’s technical understanding / capability places us within a select crowd of HDD service providers in Africa, underpinning our vast management experience.

We recently in April of 2016 completed the longest single drill in Africa in terms of distance (3.1km x 16” Arepo /Imagbon line on the Atlas cove to Mosimi Pipeline).

Also, we hold the record in depth of crossing in Africa with the successful completion of the 36” x 1.2km Ekiadolor Deep Valley Crossing. This installation was achieved at a depth of more than 80m in February of 2016.

1.3.3 HDD Thailand–Enikkom Limited

With record growth in the past decade of pipeline construction in the oil and gas industry (especially pipeline construction by HDD method), ECL together with THE E-PLACE, once again saw the need to reposition itself to harness this growth and in May 2020, ECL and THE E-PLACE formed HDD THAILAND – ENIKKOM LIMITED (HDDTEC), to cater SOLELY for the numerous Pipeline Construction (Land & Swamp, Offshore, Horizontal Directional Drilling-HDD, Horizontal Drilling-Thrust Boring) opportunities coming out in the oil and gas industry.

At HDD THAILAND – ENIKKOM LIMITED, the E-PLACE LIMITED handles the corporate and administrative responsibilities of the company, while ENIKKOM CONSTRUCTION LIMITED in Strategic Alliance with her Technical Partner, HDD THAILAND, handles the Engineering, Procurement and Construction responsibilities of HDD THAILAND – ENIKKOM LIMITED.

1.3.4 Pipeline Infrastructure Enikkom JV Ltd

Pipeline Infrastructure ENIKKOM JV Ltd is a joint venture between OCEAN MARINE SOLUTIONS LTD (OMS) and ENIKKOM CONSTRUCTION LIMITED (ECL). The Company was set up for the sole purpose of Infrastructure Development, Maintenance and Management in the Oil and Gas Industry.

OCEAN MARINE SOLUTIONS LIMITED (OMS) was formed in 2007 to provide innovative solutions to the rising spate of offshore and maritime security threats that attempts to cripple the petroleum upstream operations with the attendant huge economic loss to corporate organizations and the government. OMS, as the pioneer Private Maritime Security Company (PMSC) introduced the novel approach of strategic partnership with the Nigerian Navy to

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provide a resilient and efficient methodology to effectively counter offshore threats and provide vital static asset protection to the oil and gas industry and much needed escort services for commercial vessels transiting through Nigerian waters.

OMS operate an impressive fleet of over 40 purpose-built Patrol Boats, fitted with comprehensive communications equipment enabling full situational awareness for our clients' enhanced protection which are coordinated from our Security Operations Centres (SOC) in Lagos, Warri & Port Harcourt and sprawling ship maintenance workshops at the aforementioned locations. The OMS SOC centres are managed by well-trained security specialists, both local and expatriate, who have extensive experience in the global maritime security sector. These SOC Centres, manned 24/7/365 by our well-trained watch keepers, are all equipped with dedicated automatic Identification System (AIS) technology, which along with substantial VHF, HF and satellite systems, ensure uninterrupted communications and continuous situational awareness of all our maritime operations. OMS create the enabling platform to the Nigerian Navy to maintain a greater presence at sea and enhancing her surveillance and information gathering capabilities.

With a sustained and increasing global focus on the challenges of piracy in the Gulf of Guinea, we pride ourselves on delivering the best possible security solutions to the oil and gas and shipping industries with a proud success record of maintaining a 100% success in deterring threats from piracy and terrorism, operating in one of the most complex environments in the world.

OMS has extended her track record of excellence in security management to the security and maintenance of the Nation's pipeline infrastructure in the volatile Niger Delta region for constant delivery of crude oil feedstock to the refineries for local consumption. Current pipeline security and maintenance operations include the following segments:

24" x 60kmEscravos – Warri Crude Oil Pipeline

24" x 56km Bonny – Port Harcourt Crude Oil Pipeline

16" x 36km Opuama – Otumara Crude Oil Pipeline (OML 40)

87km Multi-Diameter Trans-Forcados Crude Oil & IN-Field Pipelines

1.3.5 HDD Thailand International

HDD THAILAND is a major player in the International Oil industry. They are one of the foremost Horizontal Directional Drilling Engineers and Contractors in the world. They provide Engineering/Drafting Services, Project Management from Project Definition/Feasibility Studies to Equipment and Materials Procurement/ Installation and commissioning.

For our Directional Drilling projects, HDD THAILAND provides ENIKKOM with Engineering services, Project Management Services. HDD THAILAND has implemented quality assurance procedures that are consistent with ISO-9001 certification.

1.4 CORE VALUES, QUALITY, HEALTH, SAFETY & ENVIRONMENT (QHSE)

1.4.1 OUR VISION

To Be the Foremost and capable indigenous Engineering construction company in Nigeria, committed to pushing limits and breaking records and to offer the BEST SERVICES obtainable in the industry

1.4.2 OUR MISSION

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To offer innovative and cost effective solutions to our Clients

1.4.3 QUALITY

To establish a Documented Quality System.

To Demonstrate Compliance with ISO Standard and Effectively Communicate to All Employees, the Benefits of implementing a quality System to Comply with ISO Standards.

Our Quality Management System (QMS) ensures we deliver quality services and products to clients and partners and is the backbone of our operations as a company. Recognizes the responsibility of all employees to foster a culture that is consistent with standards of quality and conforms to customer and company requirements. We are committed to continually getting better in all areas, with the responsible use of technology and industry-leading programs

Enikkom is proud to operate in full accordance with the ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 standards, ensuring the highest internal and external management systems. The documented QA and HSE system, adopted as a guide of success, follows a four-level model as follows:

- I. Policy and Authority Statement Manual
- II. Quality Assurance and Safety (HSE) Procedures
- III. Specific Work Instructions
- IV. Quality and Safety Records

1.4.4 SAFETY

An inseparable part of our organizational culture, Safety is fundamental and non-negotiable, and it must guide all of our actions and commitments. Our safety culture encompasses the behaviors, beliefs, and values that all of the people at our Company share as a way of controlling the risks present in our activities.

Our aim is to pursue our "zero accidents" goal, and we focus on facilities, processes, and people to achieve it. Prevention, incident analysis, communication, and improvement measures help us to control and manage risks.

Safety is ENIKKOM's Number One priority. Our equipment fleet passes the very highest standards and codes, such as the International Safety Management (ISM) code. Our equipment also undergoes a continuous preventative maintenance program, aimed at ensuring peak levels remain constant.

Enikkom is committed to reinforcing a 'safety comes first' culture with its employees and clients alike. In addition, we have implemented a new Occupational Safety and Health program (OSH) which involves two main elements: personal protective equipment and job hazard analysis.

1.4.5 ENVIRONMENT

We are committed to sustainable development through environmental protection.

We are dedicated to meeting the needs of our society today and to minimizing the impact of our actions on future generations and on the environment.

We recognize our responsibility to — and the importance of — being a responsible steward of the environment

1.4.6 COMMUNITY

We believe strongly in giving back and being good community citizens. Social responsibility is not a buzzword for us; it's how we do business. We strive to be a model business and contribute positively toward improving the communities we live and work. Our community involvement initiatives span our entire geographic footprint and allow our people to give back in meaningful ways.

1.5 OUR CLIENTS

List the Clients below and use their logos so that they will slide across the web page

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Niger Delta Power Holding Company Limited
NPDC / ND Western
MOPOL Engineering Services Limited
NIPCO Plc
Nigeria National Petroleum Corporation (NNPC)
Zakhem Construction Nigeria Limited
Gramen Petroserv Nigeria Limited
Green Gas Plc
MSI Africa Development Limited
Kaztec Engineering Limited
Pipelines and Products Marketing Company Limited
Saipem Contracting Nigeria Limited
Apapa SPM Limited / OANDO Plc
Oilserv Limited
Niger Delta Petroleum Resources
Lagos State Ministry of Works & Infrastructure (LSMW&I) / PPMC
Nigerian Gas Company
Tyvonne Nigeria Limited
Willbros West Africa Inc.
West Africa Offshore Services Limited
Azikel Nigeria Limited
JDP Construction Nigeria Limited
Seltex Oil & Gas Nigeria Limited
Shell Petroleum Development Company of Nigeria Limited

1.6 TESTIMONIALS

DANGOTE FERTILIZER LIMITED

we would like to compliment ENIKKOM Construction Company on the outstanding job on the just concluded 36" x 1.5km swamp/river crossing. Their presence and work ethics has really made a huge impact. Impressive drilling work done by your team.

ZAKHEM CONSTRUCTION NIGERIA LIMITED

ECL has now successfully completed a number of crossings using the Horizontal Directional Drilling (DD) method on behalf of ZCL. We have found their team to be refreshingly co-operative and attentive. ECL, brings a level of client side understanding to each and every project they are engaged on, this help us to include ENIKKOM as the preferred contractor of

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choice when considering all projects. We have no hesitation in recommending ECL for the services they provide.

GRAMEN PETROSERVE NIGERIA LIMITED

Enikkom has provided Horizontal Directional Drilling services to our company, having satisfied our requirements for efficient work. This was made easy as the company had the right equipment and team despite the difficult terrain.

SAIPEM CONSTRUCTION NIGERIA LIMITED

We are delighted with our experience of working with ENIKKOM over the duration of our project. We have found all staff from senior management down to the site delivery team to be friendly, cooperative, helpful and very professional. It was a pleasure working with the team and we definitely will look forward to our next project together.



The image shows the cover of the SAIPEM Briefly newsletter for March 2016. The cover features a dark blue header with the SAIPEM logo and the word "Briefly" in a stylized font. Below the header is a red banner with the text "March 2016". On the left side, there is a portrait of Rosemary Ehiogu with the word "editorial" written vertically next to it. The main article title is "NIGERIA Gets Another Boost on Otumara Project". The text discusses the successful completion of a long HDD pull in Nigeria. A photograph of a team of workers in orange uniforms cheering is included. At the bottom right, there is a "Continue on page 2" button.

NIGERIA Gets Another Boost on Otumara Project

IGERIAN Content Development in the oil and gas sector gained yet another boost on the 20th of March 2016 , with the sucessful completion of the longest HDD pull ever done in Africa by Nigerians on SCNL's Otumara project. The Otumara-Saghara-Escravos Pipeline Project is an EPC Contract awarded by Shell Petroleum Development Company of Nigeria limited (SPDC), as part of Shell's program to reduce gas flaring in the Country.

The 42-kilometre-long pipeline, of various sizes ranging from 2 to 12 inch, passes through swampy terrain and dry land including a major river crossing. The pipeline will collect about 30 million cubic feet a day of processed associated gas from the Otumara and Saghara fields in the western Niger Delta and send it through the Escravos-Lagos system to the domestic market, helping to reduce flaring, or the burning of gas produced alongside oil.

Jubilation at the HDD string exit point at the NGC HDD site

The Construction Manager Alufa Austin on announcing the successful completion of the 2.8km HDD operation on behalf the Project thanked all the team members for their contribution towards the success of the unprecedeted and challenging task .

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In the same manner Saipem's Onshore Operations Manager, Mr Davide Rossi expressed Management's delight in the achievement of the project team as this is the first project in Nigeria to achieve a 2.8 kilometers of Horizontal Directional Drill pull across the Escravos River which is the longest of such HDD operations in Nigeria. He noted that this is particularly instructive because it was achieved with an indigenous company ENIKKOM Construction Limited

With the mix of SCNL experience and ENIKKOM management, the team (ENIKKOM and SCNL) spent considerable time in preparing the design of this job, developing a detailed engineering for the entire operation which comprises of 5 phases: drilling of the pilot hole; reaming of wider hole 18"; reaming a 24 "size hole; swabbing or cleaning the hole; and pulling back the pipe. During these steps the stability of the drilled hole is guaranteed by pumping bentonite and additives into the hole. The whole system is then kept under pressure to avoid any collapse.

The operation itself was unique, highly fragile and must not fail. After performing an accurate geotechnical survey, ENIKKOM and SCNL executed the job by using the "intercept methodology". SCNL prepared at the two extremes of the crossing two working areas meant to accommodate ENIKKOM's rigs of 300 tons and 500 tons which drilled simultaneously to connect the two ends.

Otumara-Saghara-Escravos pipeline project in pictures



HDD Site during the pullback operation.

In line with the Nigerian Content Policy, the project was fully achieved in Nigeria with cooperation from key contributors involving communities and sub-contractors partnering with Saipem Contracting Nigeria Limited to meet completion.

SCNL is proud of its achievement in practically demonstrating the spirit of the Nigerian Content which translated into provision of several direct and indirect jobs, bringing business to the rural communities, discouraging capital flight, and boosting local capacity in course of the project.

"...Congratulations," for a job well done.
Keep up with saipem *Guido D'Aloisio*

Key Project Nigerian Content Performance (30.03.2016)

Total Project Hours	2,015,885
Hours Achieved with Nigerians	1,842,720
Nigerian Content %	92%
NHCD Training Hours	15,432



About Us

Enikkom Group is a leading engineering, procurement, fabrication, construction, and installation (EPCI) company, delivering comprehensive project management and support services for onshore and offshore flowlines, pipelines, and facilities across Nigeria. With decades of experience, we provide innovative, precise, and sustainable technical solutions tailored to meet the unique needs of our clients.

Indigenous company, established in 1995, we leverage a rich pool of skilled professionals, modern equipment, and specialized services to deliver bespoke infrastructure solutions nationwide. Our resilience, technical depth, and commitment to excellence make us a trusted partner in Nigeria's oil and gas sector.

OUR SUBSIDIARIES

Enikkom Construction Limited (ECL)

Incorporated in March 2009, ECL was established to focus exclusively on **pipeline construction and associated infrastructure works**. Recognizing the significant opportunities within Nigeria's pipeline sector, ECL was created as a dedicated company to deliver specialized services efficiently.

ECL is a pioneer in **Horizontal Directional Drilling (HDD)** in Nigeria, completing the first HDD crossing of the River Niger in 2003. The company combines deep local expertise with a commitment to delivering projects safely, on time, and to specification.

HDDThailand – Enikkom Limited

To enhance its HDD and trenchless technology capabilities, ECL partnered with **HDDThailand Co. Ltd**, a global leader in trenchless solutions with over 15 years of international experience. This partnership gave rise to **HDDThailand–Enikkom Limited**, a specialist company providing advanced HDD and pipeline construction services.

Through this collaboration, the company merges **over 22 years of Nigerian HDD experience** with **global best practices**, delivering world-class trenchless technology solutions across the oil and gas sector.

OUR MISSION

To be the benchmark of excellence in engineering and construction solutions in the energy and infrastructure industries

OUR VISION

To create exceptional value for stakeholders through innovation, technology and sustainability; delivered by a high-performing, motivated and engaged workforce

OUR CORE VALUES

- Performance
- Resilience
- Innovation
- Care
- Expertise

Company Overview

Enikkom Group is a leading engineering, procurement, fabrication, construction, and installation (EPCI) company, providing end-to-end project management and support services for onshore and offshore flowlines, pipelines, and facilities. Leveraging decades of industry experience, we deliver precise, innovative, and sustainable technical solutions across Nigeria.

As a wholly owned subsidiary of Enikkom Investment Services Nigeria Limited (EISNL), established in 1995, Enikkom Group draws from a rich pool of highly skilled professionals, modern equipment, and tailored services to deliver bespoke infrastructure solutions nationwide. Our resilience, technical depth, and commitment to excellence distinguish us as a trusted partner in Nigeria's oil and gas sector.

Enikkom Construction Limited (ECL)

Incorporated in March 2009, Enikkom Construction Limited (ECL) was established to focus exclusively on pipeline construction and associated infrastructure works. ECL was established as a result of the realization of the huge opportunities which the pipeline construction business presents in Nigeria and the need to setup a dedicated company for the purpose of exploiting these opportunities.

ECL is recognized as a pioneer in Horizontal Directional Drilling (HDD) in Nigeria, completing the first HDD crossing of the River Niger in 2003.

HDDThailand – Enikkom Limited

To further strengthen its HDD and trenchless technology capacity, ECL partnered with HDDThailand Co. Ltd, a global leader in trenchless solutions with over 15 years of international experience. This collaboration gave rise to HDDThailand–Enikkom Limited, a specialist infrastructure company focused on advanced HDD and pipeline construction services.

Through this partnership, the company combines over 22 years of Nigerian HDD experience (via ECL) with global best practices and innovations from HDDThailand, delivering world-class trenchless technology solutions to the oil and gas industry.

Our core capabilities include:

- Pipeline Construction (Land, Swamp and Offshore)
- Horizontal Directional Drilling - HDD for rivers, roads, swamps, rail lines, and urban crossings
- Horizontal Directional Drilling - Thrust Boring
- Steel and Metal Fabrication (Storage Tanks, Process works)
- Dredging Works
- Geotechnical Survey
- Equipment Leasing
- Civil Construction (Piling, Jetty, Bridges etc)

ENIKKOM is the pioneer and leading Horizontal Directional Drilling (HDD) contractor in Nigeria, with the largest fleet of Horizontal Directional Drilling rigs in Nigeria – 7 (No's maxi HDD Rig), 3 (No's mini-HDD Rig), 4(No's Micro-tunnelling and Pipe Jacking Machines) and

6 (No's Pipe Thrust Boring Machine). The following are some of our Maxi equipment in country:

HDD Rigs:

- | | | |
|--|---|-------|
| • 500 Ton HDD Drilling Rigs (500 Ton Pullback Capacity) | - | 2 Nos |
| • 300 Ton HDD Drilling Rigs (300 Ton Pullback Capacity) | - | 3Nos |
| • 200 Ton HDD Drilling Rigs (200 Tons Pullback Capacity) | - | 2Nos |
| • 150 Ton HDD Drilling Rig (150 Tons Pull Back Capacity) | - | 1Nos |
| • 100 Ton HDD Drilling Rig (100 Tons Pull Back Capacity) | - | 1Nos |
| • 50 Ton HDD Drilling Rig (50 Tons Pull Back Capacity) | - | 1Nos |

Micro Tunneling & Pipe Jacking Equipment:

- | | | |
|--|---|------|
| • 48" Micro Tunnelling Equipment and accessories - MTS | - | 1Nos |
| • 800 Ton Pipe Pusher - TSG | - | 1nos |
| • 750 Tons Herrenknecht Thruster | - | 1Nos |
| • 380 Ton Pipe Pusher – Prime Drilling | - | 1Nos |

Thrust Boring Machines:

- | | | |
|---|---|------|
| • 72–1200 NG Thrust Boring Machine | - | 1Nos |
| • 48/54–G900 Thrust Boring Machine | - | 1Nos |
| • 42"/48" – G600 Thrust Boring Machine | - | 1Nos |
| • 36"/42" - 600 Pounds Push Capacity | - | 1Nos |
| • 36 " – 340 Pounds Thrust Boring Machine | - | 1Nos |
| • 24 - 100 Thrust Boring Machine | - | 1Nos |

Our project portfolio reflects our unwavering dedication to achieving client objectives meeting targets efficiently and effectively, while upholding industry best practices and safety standards. [*Link to Project Portfolio*](#)

Track Record & Achievements

- Pioneers of HDD in Nigeria since 2003, with 10 HDD rigs and counting.
- Successfully completed over 100km of HDD installations within the last 16 years, covering diameters from 4" to 40" and lengths ranging from 50m to 3.1km in a single drill.
- Holder of multiple African HDD records, including:
 - Longest single drill: 3.1km x 16" (Arepo/Imagbon line on the Atlas Cove–Mosimi Pipeline, April 2016).
 - Deepest HDD crossing: 36" x 1.2km Ekiadalor Deep Valley Crossing at over 80m depth (February 2016).
 - Largest pipeline size crossing in Nigeria (at the time of completion): 40" x 760m River/Road Fish Pond Crossing for Daewoo/SPDC, completed in January 2010 at a burial depth of 100ft with a 1" pipe wall thickness.
 - Longest bundled crossing in Africa (at the time of completion): SPDC Otumara-Escravos Pipeline Project for Saipem/SPDC, involving a 12" + 3" x 2.78km bundled crossing executed using the intersect method with two HDD rigs (300T and 500T).
 - Longest functional continuous HDD crossing in Nigeria (at the time of completion): 12" x 10km pipeline installation in OML34 for NPDC at Utorogun, Warri, Delta State,

Why Enikkom?

- Over 25 years of industry experience through the Enikkom Group.
- Proven technical capacity and innovative HDD expertise unmatched in Nigeria.
- Indigenous company with deep local knowledge and international partnerships.
- A consistent record of delivering complex projects safely, on time, and to specification.

OFFICE AND FACILITY

S/N	Name & Address of Facility	Scope of Activities	Type of Facility
1	OFFICE 1 - HEAD OFFICE (ABUJA) 11, 65Road Abuja Model City, Gwarinpa, F.C.T. Abuja Nigeria.	ADMINISTRATIVE HEADQUARTERS	ADMINISTRATIVE HEADQUARTERS
2	OFFICE 2 - LAGOS No 5b Theophilus Orji Street, Lekki Phase 1 Lagos Island, Lagos State.	CORPORATE & ADMINISTRATIVE HEADQUARTERS Equipment and Vehicle	CORPORATE OFFICE
2	BASE - 1 7 Joseph Ogunjobi Street, Praise Hill Estate, Arepo, Ogun State. Nigeria.	PROJECT & ADMINISTRATIVE HEADQUARTERS	PROJECT OFFICE / FABRICATION AND MAINTENACE YARD/ STORAGE FACILITY/ WAREHOUSE
4	BASE - 2 Km7-DCS Road, Warri, Delta State.	PROJECT, ADMINISTRATIVE, MAINTENACE, FABRICATON BASE	BASE YARD / FABRICATION AND MAINTENACE YARD/ STORAGE FACILITY/ WAREHOUSE
5	BASE - 3 Opposite Ejovi Jetty,Opete Road, Warri, Delta State	FABRICATION, MAINTENACE YARD & LOADING OUT JETTY	FABRICATION AND MAINTENACE YARD
6	BASE - 4 Old NNPC filing station-DCS Road, Warri, Delta State.	PROJECT, ADMINISTRATIVE, MAINTENACE, FABRICATON, LOADOUT BASE	

CONTACT

Email: info@enikkom.com

Website: www.enikkom.com

Tel: +234 806 573 8555

1. Chevron Nigeria Limited

"Enikkom Group has consistently delivered exceptional project management and pipeline construction services. Their technical expertise, particularly in Horizontal Directional Drilling, has enabled us to execute complex projects safely and efficiently. We consider them a trusted partner in Nigeria."

2. Shell Petroleum Development Company (SPDC)

"The team at Enikkom Construction Limited demonstrated unmatched professionalism and innovation during the Otumara-Escravos HDD project. Their ability to manage challenging river and swamp crossings sets them apart in the industry."

3. NPDC (Nigerian Petroleum Development Company)

"HDD Thailand-Enikkom Limited successfully completed our 10km pipeline project using Continuous HDD technology. Their technical precision and commitment to deadlines exceeded our expectations."

4. Daewoo Nigeria Limited

"Enikkom's team completed the River/Road Fish Pond crossing with meticulous planning and execution. Their ability to handle large-diameter pipelines at challenging depths is remarkable."

5. Saipem Contracting Nigeria Limited

"Enikkom Construction's experience and expertise were evident in every stage of our bundled HDD crossing project. Their ability to coordinate multiple rigs and teams efficiently is impressive."

6. TotalEnergies Nigeria

"From mobilization to completion, Enikkom Group provided end-to-end project support with remarkable attention to detail. Their commitment to safety and quality is second to none."

7. Nigeria LNG Limited (NLNG)

"Enikkom has been instrumental in our offshore and onshore pipeline projects. Their depth of experience in trenchless technologies and civil construction has significantly enhanced project efficiency."

8. NNPC (Nigerian National Petroleum Corporation)

"Working with Enikkom Group was a seamless experience. Their highly skilled personnel, modern equipment, and strategic approach to complex projects made them a valuable partner in delivering infrastructure solutions."

9. MORPOL Engineering

"The Enikkom team consistently demonstrates technical excellence and reliability. Their ability to execute challenging HDD projects, including deep and long-distance crossings, positions them as industry leaders."

10. HDDThailand Co. Ltd (International Partner)

"Collaborating with Enikkom Group has been highly productive. They combine local expertise with global trenchless technology knowledge, ensuring high-quality project outcomes and innovative solutions across Nigeria."

1.1 MANAGEMENT TEAM

ENGR EDWARD AMENE – CHIEF EXECUTIVE OFFICER (NIGERIAN)

Edward Amene, a Mechanical Engineering graduate from the University of Nigeria, Nsukka, has over 37 years' experience in pipeline construction, including 14 years as a Project Engineer with SPDC. He founded Enikkom Group in 1995 and pioneered the use of trenchless technologies, including Horizontal Directional Drilling and Thrust Boring, in Nigeria's pipeline sector.

ENGR. SALEEM AHMAD KHAN – CHIEF TECHICAL OFFICER (PAKISTAN)

Saleem Ahmed Khan, a mechanical engineer from Pakistan with over 30 years' experience, specializes in pipeline construction, HDD, heavy mechanical operations, and oil & gas infrastructure. Holding a bachelor's from NED Karachi and a Diploma from the Swedish Institute, he has led complex projects for Marathon Construction, Zakhem Nigeria, and Business Supply & Technology, delivering HDD crossings, hot tapping, and pipeline expansions for clients including NNPC, Chevron, BP, Eni Pakistan, and SSGC. He brings expertise in project management, quality control, site inspections, and cost management.

TEDDY ALLEN – GENERAL MANAGER DRILLING (AMERICAN)

Teddy is an American professional with 38 years' global experience in directional drilling and pipeline installation across diverse formations, including swamps, sands, silts, shales, and granite. He is skilled with various rig types—jack-ups, platforms, semi-submersibles, and directional drilling rigs—and trained in direct pipe procedures. Teddy has extensive expertise in drilling tools, fluids, recycling equipment, and down-hole surveying systems, with a strong track record in implementing and monitoring operational and safety standards.

ADEKUNLE ADEWOLE, PHD. – CHIEF OPERATIONS & STRATEGY OFFICER (COSO) (NIGERIAN)

Adekunle holds a PhD degree in Business Administration (Strategic Management) with research focus on strategy execution and a post-doctoral diploma in organisational leadership from The University of Oxford, United Kingdom.

He also holds a master's in business law and a Certificate in Global Management from The Institut Européen d'Administration des Affaires (INSEAD), Fontainebleau, France. He is a visionary financial and management executive with over 30 years of multi-sector experiences, 9 of which has been in the C-Suite, spanning banking, corporate & structured finance, credit collections, advisory, aviation, and management consultancy.

He has a proven track record of leading transformational initiatives and driving inclusive growth through innovative solutions. Adept at board-level governance, strategic partnerships, and sustainable development finance, Kunle has been severally recognized for unlocking value across public and private sectors, with a deep commitment to institutional resilience and socioeconomic impact.

Prior to joining The Enikkom Group, Kunle was the CEO of Livingtrust Mortgage Bank Plc, leading the institution to national reckoning and improving stakeholders' values. Kunle is a fellow of the Chartered Institute of Administrators and an Honorary Senior Member of the Chartered Institute of Bankers. Kunle's hobbies are reading and discoveries. He is a member of the Manchester plane spotting club, the Ikoyi Club 1938 and the Country Club, Ikeja.

MR. FRANCIS ANATOGU – CHIEF GROWTH AND TRANSFORMATION OFFICER (NIGERIAN)

Francis is a seasoned business executive with 30 years of experience spanning energy, consulting, trade policy, and international business development.

He began his career in 1995 with Schlumberger and Shell, building strong foundations in engineering, planning, and investment decision analysis, before moving into consulting with Accenture and Deloitte, where he advised energy and resources companies on growth, market expansion, and operational improvement.

He later served as Senior Special Assistant to the President of Nigeria on the African Continental Free Trade Area (AfCFTA), leading Nigeria's accession process and becoming the inaugural Executive Secretary of the National Committee Secretariat, where he oversaw the development of the country's AfCFTA implementation strategy.

As Chief Executive of Transaharan Limited, a strategy and international market access advisory firm, Francis supports governments and businesses in competitiveness, export growth, and organisational transformation. His leadership consistently integrates growth strategy, operating model redesign, and governance frameworks to deliver sustainable performance.

Francis also serves as a Non-Executive Director at Dryva Logistics and as West Africa Advisor to the Africa Special Interest Group of the UK Institute of Directors, strengthening governance and business linkages across Africa and the UK.

He holds a Mechanical Engineering degree from the University of Nigeria, Nsukka, and an MBA from the Judge Business School, University of Cambridge

MR. CHIBUIKE NWACHUKWU – EXECUTIVE DIRECTOR (NIGERIAN)

Chibuike John Nwachukwu is a Nigerian administrator with 23 years' experience, including 15 years as Managing Director at Enikkom Group Limited. He holds an MSc in Peace & Conflict Studies and bachelor's degrees in mathematics and Peace & Conflict Studies. With extensive expertise in administrative management across local and international organizations, he drives operational efficiency, strategic leadership, and organizational excellence at Enikkom.

Management Team

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ADEKUNLE ADEWOLE, PHD. – CHIEF OPERATIONS & STRATEGY OFFICER (COSO) (NIGERIAN)



FRANCIS ANATOGU. – CHIEF GROWTH & TRANSFORMATION OFFICER (CGTO) (NIGERIAN)

SCOPE OF SERVICES

Trenchless Pipeline crossings

- Horizontal Directional Drilling (HDD)
 - Shore approach Projects
 - MSI Conoil
 - Bundled Mid-stream / River / Land fall crossings
 - Oando river crossing
 - Saipem / Otumara River crossing
 - Continuous Horizontal Directional Drilling (CHDD)
 - **OML34 / NPDC**
 - River / Swamp Crossing Projects
 - Arepo / NNPC
 - Abule Ado - Ijeododo / NNPC
 - Imagbon crossing / NNPC
 - EESP Chevron
 - LGPP Dangote
 - Land & Road crossing Projects
 - Ekiadolor / NNPC
 - 40" Daewoo projects
 - Rock & Hard terrain crossings
 - Ekiadolor
- Guided Boring (Thrust Boring)
 - Escravous road crossings
 - Tema rail crossings in Ghana
 - Agip road crossings Bonny
- Micro Tunnelling - Slurry Spoil Removal System
 - **Rv Niger Project**
- Horizontal Boring (Hole Hog)
 - NIPCO Benin Project
- Pipe Ramming (Casing Installation)
 - **Rv Niger Project (same as above)**

Conventional Open cut

- NIPCO Projects
- CMEs Pipeline project Calabar (NDPHC)
- Zakhem projects

Dredging & Piling

- Slot / Access sweeping and maintenance
 - Egweama
- Land reclamation
- Stockpiling
 - PH projects
- Capital Dredging
 - Conoil Projects
- Removal of obstruction from sea beds / waterways & canals
- Pile driving / pile extraction / Cofferdam installations (Land & Swamp)
 - OML 34
 - OB3 Project
- Shore protection piling

Production facilities construction & Operations

- Flow station and wellhead operations
- Well upgrade
- Manifold inspection and maintenance
- Plant turn around maintenance
- Structural Construction
- Greasing of wellhead and process valves
- pipeline pigging operations

ALL PROJECT LISTING

PROJECT OVERVIEW
CONTINUOUS HORIZONTAL DIRECTIONAL DRILLING
10" x 12km HDD in OML34

INTRODUCTION

Subject contract was awarded to Pipeline infrastructure Enikkom Joint Venture, a JV partner of ENIKKOM group in 2021 for the installation of 10-Inch x 12km pipeline from the Utorogu gas plant to Ughelli Pump Station by means of Continuous Horizontal Directional Drilling. The scope of work included the following

- Installation Survey, Design & Engineering of Project.
- Procurement of Line pipe/ Pipe fittings
- Mobilization of 5rig spread equipment and personnel.
- Welding of 12" X 12km Pipeline in different Sections
- NDT, FJC of the welded joints
- Hydrotest welded spools for Installation
- TIE IN
- Pre commissioning & Commissioning
- Cathodic Protection
- Demobilization.

CONTINOUS HDD

Based on evaluation and preliminary investigations on the subject project, we came to the conclusion that the installation by continuous HDD will be done in Six sections (DP0 to DP5) having 5 intersect drills due to the long distance and 1 single shot drill. When commissioned, the 10"x 12km Utorogu – UPS gas trunkline will be the longest HDD crossing in Africa. This is no mean feat and we take pride in the quality of our delivery.

During the execution of a project of this complexity, there are many risk associated but due to our experience and record breaking history, we were able to access the risk factors and take care of them as we do with every of our projects .

A CHDD crossing of this length is only made possible by introducing sectional “tie in points” at designated areas along the Right of way wherein the opposite ends of the HDD spool are welded together or “Connected” to form a single, continuous spool. Further still, the process of successfully connecting these HDD spools includes but, not limited to the following;

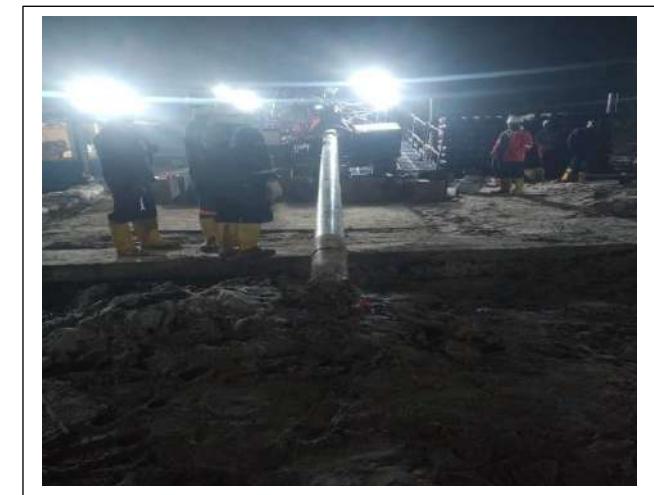
1. Construction of cofferdams to enable us reach the Tie in point of 10m.
2. The Excavation of pit to reach required depth
3. The Dewatering as area is water logged.

Every stage of this process presents a wide range of challenges. At Enikkom Construction Ltd, we live for such challenges. A typical challenge faced in cofferdam construction is the seasonal change in the level of the ground water table at an unforeseen rate. Cofferdams are by nature temporary structures

3 – PROJECT & EXPERIENCE

built to serve as a work base at predetermined depth and also keep water away from the construction site, so that execution can be carried out on a dry surface. They are mostly constructed in adverse conditions and are subject to diverse load pressures, significant changes in subsoil conditions, possible erosion as well as fluctuating ground water ingress. To solve this problem, ample provision was made to account for deviations in soil test analysis as well as extensive dewatering systems so that the final structure is constructed in line with world best practices. We latched on to our wealth of experience in River and swamp activities and introduced dewatering system made up of well points, jetting pumps, electrical water pumps etc. to constantly dredge the cofferdam to maintain a dry and HSE compliant work area. As a result of this dewatering system, we are able to carry out excavation to 8m – 10m agreed depth for the various Tie in points and successfully carry out welding, radiography and coating inspection on our HDD spool in safety.

At Enikkom Construction Ltd. we help our clients compete on the global scale with accelerated revenue growth as they can now make more accurate, long-term forecasts of regional crude and associate product demand caused otherwise impacted by man-made & environmental events. We also help them promote stable processes, mitigate supply chain risk, and improve resilience in our clients' operations in the most volatile and hard-to-reach areas. We take pride in our ability to rapidly mobilize equipment, personnel and materials to tackle challenges as they come. This tight "feedback loop" helps our project management team collaborate better, and react quickly to clients' needs and market changes. On every project, we make sure to constantly improve on our past record for mobilization in the face of challenges. Indeed, this agile approach to engineering project management is at the heart of our operations and is our guaranty to our clients of top-class, safe and sound execution of EPC projects.



Stabilization of drill pad, Perimeter fencing of (50m x 50m) in preparation for site set up

Jetting and to commence Pilot Hole

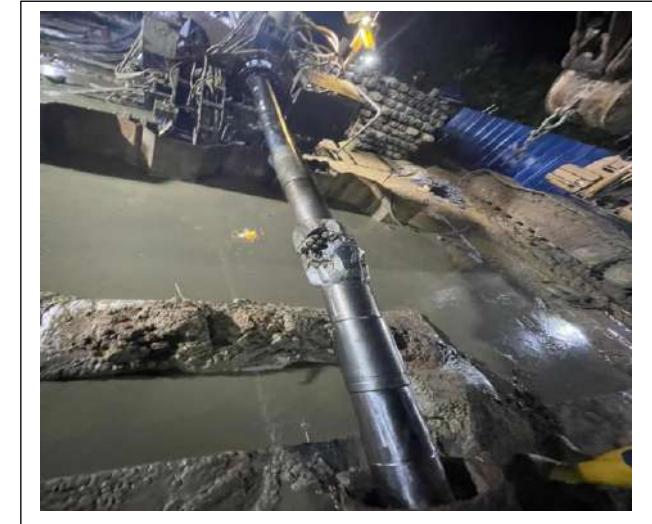
3 – PROJECT & EXPERIENCE



Pilot Hole Drill



Installation of 16" casing @ Entry Point



Complete Pilot hole by Intersect method



Set of PL Over bend design



Installation of cofferdam for Tie in @10m



PROJECT OVERVIEW
MICROTUNNELING & PIPE RAMMING PROJECT
Obiafu-Obrikom-Oben (OB3)48" x 1.8km Gas Pipeline Project

INTRODUCTION

HDDThailand - Enikkom Ltd was awarded the 48" dia x 1.8km Pipeline River Niger crossing to transport gas from the eastern end of the river to the western end using a combination of Horizontal directional drilling (HDD) and Direct Pipe installation (DPI) Trenchless technology.

HORIZONTAL DIRECTIONAL DRILLING

HDD Rigs (A 500T and 300T) and crew mobilized in Q4 2020 successfully drilled the pilot hole with intersect at KP16, and reamed to 36". The HDD crew was thereafter demobilized in December of 2020. The aim was to reconfirm the soil condition along the ROW.



Mobilization to site for HDD operations



Site Set up @ KP15



Site Set up KP17

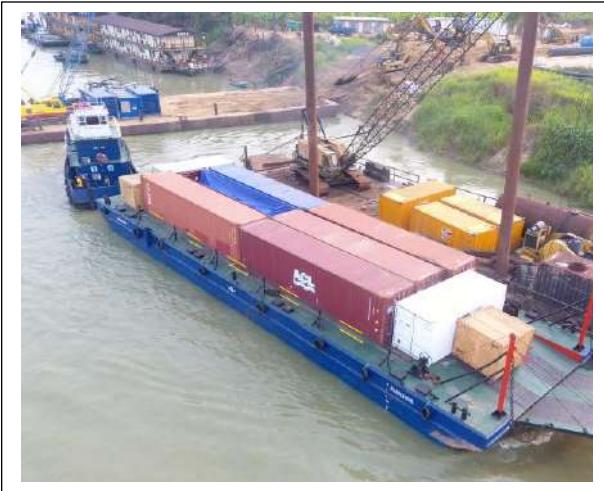
MICROTUNNELING

Set up for Direct pipe jacking system commenced in January 2021 with construction of a solid structural base to withstand load in excess of 700 kN and subsequent mobilization to site of the crew from MTS Germany in Q1 2021.

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The Jacking system was designed to clamp a pipe length of 300m at every thrusting. The 1800m pipeline already welder by previously contractor has to be cut in 300m spools.



Mobilization of Micro tunneling Equipment



Installation of sheet piles for



Positioning and set up of equipment



Launch of TBM and commence installation



PECULIAR SITE CHALLENGES – PART 1

At the commencement of operation drive on 15th of May 2021, stopped at 30 m when the push load went up, observed the Thrust boing machine (TBM) was dropping. Had a drop of 1m. [Check on equipment showed bolts holder equipment together shared](#). Bolts replaced and connection piece fabricated and welded in place inside the TBM. At restart of tunnelling operations after repairs, angle was observed to be dropping at 30m. At 40m, pushing load went to 170 tons as against 30 tons planed and also a drop of 3m below planned profile. Decision to terminate operation and review situations. TBM was pulled out.

EXECUTED STRATEGY ADOPTED TO MITIGATE KNOWN CHALLENGES – PART 1

- Installation of 60" dia. Casing pipe from the front of the Launching shaft to a distance of 48m and depth of 10m at the deepest.
- Ground grouting from the tip of the casing pipe (48m from shaft) to some meters, approximately 30m further to the river bank
- Improved steering head weight with 3 no. additional empty trailer to bring the TBM to near zero buoyancy
- Ground radar penetration survey carried out to re-establish the geotechnical survey across KP 15 – KP 17

With the implementation of highlighted actions and modifications, product pipe pushing operations resumed effectively on the 28th of December 2021.

PECULIAR SITE CHALLENGES – PART 2

After restart of operations, it was observed at 178m into the operations that slurry pumps were found leaking excessively, the pumps were modified under OEM instructions and again at 188m into the operations the offending pumps were rebuilt again at this time and all new pumps were ordered from the supplier while operations continued

Tunnelling continues up to 421m at 220 tons push force from the 190 ton force required before the tie-in, this was not deemed unusual due to an additional 310m string adding to the drag on the pipe. However each shift an increase in push force is detected, all lubrication parameters are scrutinized and found correct, no change in formation was perceived. At 431m push force rises to 240 tons, clamps are slipping due to the condition of the pipe and glazed over. Some courser river gravel was becoming more evident over the shakers.

all lubrication lines were checked internally on the machine, the front lubrication nozzles were manually closed to direct all lubricant away from the head due to the theory of underground water washing away the lubricant, one of the rear nozzles was blocked and subsequently cleared and re-installed, all parameters were as expected.

slipping clamps were cleaned and tunnelling recommenced, additional lubrication was pumped into entry seal and to the machine, clamps failed again and tunnelling unable to start due to clamps moving at 270 tons. Even though no tunnelling had been carried out spoil continued to be separated over the shakers consisting of at least 4m³ of course sand and gravel indicating material is being washed into the cutting chamber whilst static

INVESTIGATION

Removed the entire launch seal and built a 100% polymer and lube fluid, the theory was to replace all the bentonite from the machine along the tunnel. However after pumping over 30m³ there was no bentonite appearing at the launch seal and the pressure in the chamber did not increase. The operators

operated the interjack cylinders inside the machine to manipulate the area around the machine but it was noticed that after pushing 20cm the cylinders were put into float, (a neutral state where oil can flow to either end of the cylinder), the cylinders snapped closed. This is another indicator of some substantial hydraulic ground pressure and absolutely not normal. It appears that all of the lubricant pumped has been washed into the formation.

Investigation of the Island within the 420m to 450m section of the ROW (The tunneled 30m) revealed some cave in on the surface

CAUSES

Careful evaluation of all the possible causes revealed that the fault is most probably attributed to lose ground formation not captured in any previous Geotechnical Soil Investigation.

EXECUTED STRATEGY ADOPTED TO MITIGATE KNOWN CHALLENGES – PART 2

- Deploy and Execute High Scan GPR to isolate particular soil type.
- Carry our Scan across the entire ROW and further bore boles along highlighted trouble spots from the scan results.
- Grout/Recondition the highlighted unstable sections along the ROW.

PROJECT OVERVIEW
RIVER / SWAMP CROSSING PROJECT
36" x 2km Pipeline crossing for Dangote Fertilizer

INTRODUCTION

Drilling beneath bodies of water for HDD (Horizontal Directional Drilling) comes with diverse challenges that vary from one project to another. Consequently, Ejirin HDD project located on the Lagos lagoon presented its own peculiar challenges and it was another experience entirely for ENIKKOM who recently finished a similar installation of 36" x 1.5km crossing by HDD within the same axis.

The Lagos lagoon is approximately 50 km long and up to 13 km at its widest point, separated from the Atlantic Ocean by a long sand spit 2 to 5 km wide, which has swampy margins on the lagoon side. Its surface area is approximately 6,354.7 km². The lagoon is fairly shallow and is not plied by ocean-going ships, but by barges and boats. The lagoon receives the discharge of the Ogun River and the Osun River. the crossing channel then goes through the pass between both river banks termed the Pipe side and Rig side.



Stripping of Rig side in preparation for sand filling



Dredging to sandfill the Rig side



Sand filled Pipe Side area in preparation for site set up

3 – PROJECT & EXPERIENCE

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Hook up and spud down for pilot hole drill



Completed casing installation & continue pilot hole drill



Completed pilot hole



Site up of Equipment on barge at Rig Side



Arial View of set up on Rig Side

PROJECT CHALLENGE – Part 1:

Owing to the terrain in Ejirn, dredging had to be carried out first for stability before the rigs could be set up for drilling. Infact, the reclamation was done up to an average of 6m depth before stability could be achieved at the exit point (pipe side) which took months of day and night dredging and for wants of time.

The long pilot bore got off to a good start, An American Auger 300ton (600,000lb) rig was used to drill the pilot shot from the exit point. The 6-5/8" pilot bore proceeded down at desired angle and depth below the swamp and river bed, and proceeded to the entry point.

EXECUTION STRATEGY ADOPTED TO MITIGATE KNOWN CHALLENGE – Part 1

barges were used as the platform for setting up the rig and support equipment at the entry point (rig side).The barges hard to be reinforced using piles, H and I Beams and bracings

PROJECT CHALLENGE – Part 2:

The pilot hole was completed in 24 days (while trying to stabilize the entry point due to bad ground/terrain) including 16" casing installation for stabilization and mud control then proceeded with various reaming passes (16/18", 22/24", 28/30", 34/36", 40/42", 46/48" and 48" clean pass) but difficulties arose with 48" back reaming to enlarge the hole.

HDD drill pipe end was decoupled during drilling operation about 50 meters away from HDD entry pit. The pipe had gone to between 10 to 15 meters depth under the river bed. Using a high tech metal detector to determine the point and depth of decoupling, the pipe was located at about 13m under the river bed under the mud of the swamp section. In such situations, the hole may be abandoned and a new bore made adjacent to it. However, in this case, the job would have had to be re-permitted, taking as long as 6months. That couldn't be afforded, because it would cause us to miss the contract's completion date. Liquidated damages would be assessed for each day past the deadline, and the daily cost would be substantial.

EXECUTION STRATEGY ADOPTED TO MITIGATE KNOWN CHALLENGE – Part 1:

To solve this problem, we decided to build a coffer dam around the area of decoupled drill string and introduce divers with specialized equipment to hook up to the tail end of the loose drill string. But first the area needed to be swept with a dredger to a depth of -6m. This will reduce the depth of coffer dam to be installed through the mud to – 7m and then the precise location needed to be known so a magnetometer probe was introduced. Several grid-lines transverse to the axis of the drill-string was ‘run’ and fixes made on the sensors ‘hits’, with several hits plotted, the actual longitudinal axis of the pipe is determined. The survey team now plots the longitudinal axis of the pipe (drill sting) into their equipment and runs the magnetometer along this axis until they detect the end of the pipe. And then the dredger moved in and commenced sweeping. The cofferdam is built to give workers a dry work environment to allow for the retrieval of the buried drill string which would otherwise be difficult. To enable quick retrieval process, a 15m x 72" Ø casing was used in place of building a cofferdam. Prior to commencing positioning of the coffer dam (15m x 72" Ø), a confirmatory survey was be carried out and the edge of the pipe marked and reconfirmed. This is then further confirmed by blowing air through the pipe from the other end of the drill string.

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On installation of the cofferdam, the mud inside is pumped out by means of an Electric Toyo Pump and Water is simultaneously pumped into the coffer dam as mud is being pumped to ensure pressure equalization within the coffer dam. Once the cofferdam has been fully installed to 13m, Divers will then dive in and manually probe the bottom to manually locate the pipe which should be +- 1m from the edge of the coffer dam. The actual distance is measured. Divers will then dive in and clean the end of the pipe and screw on a prefabricated cap to the end of the unscrewed drill string. A 40-ton Swivel with one end attached to a cable is then coupled to the end cap on the drill string. Once the tail end was hooked up and attached to a 500ton rig, tripping out drill rods began to exit the 48" reamer. Back reaming was resumed. The HDD segment was completed prior to the deadline.



Installation of 72" cofferdam



Introduction of driver to hook up to tail end of loose string



Successful hook up and extraction of cofferdam

LESSONS AND OBSERVATIONS

Even as a leading HDD contractor in Nigeria, we cannot control all of the trials and tribulations that may come with drilling activities. However, on every project it is our goal to demonstrate to our clients that we can be trusted to overcome these challenges as they occur. Indeed in the HDD business, it's not a matter of if, but when. Everyone has been stuck at one time or another. It takes finesse, experience and luck to get free.

PROJECT OVERVIEW **ROCK & HARD TERRAIN CROSSING** **Ekiadolor crossing**

Introduction

Prior to mobilizing to location at Ekiadolor Benin state, we had carried a further soil geotechnical survey as accompany standard process. In addition to the rock coring test, we carried out Soil Resistivity test (both out of Scope Test) to enable us determine the type of soil under the rock across the entire ROW. After a review of the results, it immediately became obvious that the Ekiadolor crossing was not a normal crossing. The manual soil bore equipment used couldn't penetrate beyond 30m at the deepest point. It was then obvious that we were dealing with some form of rock.

The result showed a complex soil mix not usually advisable for HDD. Having profiled the soil strata on both sides of the valley at depths of 80m the crossing was designed and detailed engineering carried out. Choice of tools and additional equipment were made and subsequently procured as it became obvious that the normal tools used in the other crossings will not work with this crossing.

Peculiar Site Challenges – Attempt 1

- Deep Valley - Difference in elevation of 40m between highest and lowest Points along the ROW.
- Very Corrosive Soil. Extensive wear on reamers, pumps and rigs, mixing and recycling units. Also wears out the drill pipes collars requiring extensive inspection and recut when found defective
- No direct access between exit and entry points because of the valley. Between Very unstable soil strata.
- The Northern and southern banks of the valley are very steep and just prior to our commencing site investigations had extensive erosion control works carried out at the banks in steps. Hence impossible to get motorized equipment into the valley without damaging the erosion remedial works carried out at the banks.
- We were only limited to coring at both exit and entry points.
- STUCK: The 24" and 36" reaming passes were also successfully completed using the modified 24" and 36" Hybrid Reamers. However, at about the same area where the 42" reamer eventually got stuck, the 24" and 36" reamers stopped temporarily but continued turning when a specially formulated chemical pill was pumped and circulated around the reamers.

Execution Strategy Adopted To Mitigate Known Challenges

- Engineered crossing Profile such that the 80% of the horizontal section of the profile goes through the Shale rock section (Stable Soil) of the ROW
- Core the rock formation to a depth of 80m taking samples in core glasses to aid drilling operations
- Stay a minimum of 20m below the stream/river bed.
- Mobilize bigger capacity mud mixing and recycling units (10,000 ltrs capacity mud mixing and recycling units) at both exit and entry locations.
- Back up most of the critical equipment's, including additional equipment mobilized to site to improve mud handling capacity.

- Install a water line from the river to the rig side to ensure adequate water availability We had 2 No Deep-water wells at the rig side and 1 No Water well up the hill at the buoyancy end. This still was not enough because of the loss of returns into the fault. Hence the need for back up water from the stream.
- Procurement of fit for purpose special Hybrid reamers from
- Procurement special Rock Drilling Tools, Mud Motors, reamers

Lessons and Observations from Attempt 1

On failing to recover the stuck 42" reamer after the drill string broke, we did an in-depth analysis of the events leading to the reamer getting stuck. In order to live up with the challenges posed by this peculiar crossing, we had to procure a lot of additional equipment, tools and consumables. We also experienced Very High level of wear and tear on our equipment. In some cases reamers were written off after a single reaming pass. Drill pipes that were normally inspected at the end of each project were being inspected after each reaming run. We also experienced very high wear on the subs and drill pipes leading to re-cutting of the drill pipes several times and in some cases outright replacement

Peculiar Site Challenges – Attempt 2

After the first attempt, an in-depth review of the whole process was carried out, failures and further challenges highlighted. A new strategy was then adopted to ensure a successful second attempt.

Having drilled the failed crossing through the perceived most stable section of the soil and with the broken pipe string still stuck in the hole, the challenge became where to drill the second pilot hole. We proffered various options. It was agreed to go deeper under the 10m rock bed. We also had the following additional challenges to contend with:

- The Mud fracking out at the valley could overflow the bund wall, hence it was decided to include a mud return line to be used to pump mud back to the rig side for cleaning and recycling.
- Experiencing heavy losses down hole. Special Mud pills pumped down hole could not fully mitigate this peculiar challenge.
- The water borehole became entirely inadequate since we needed to mix mud more frequently.
- Very sticky and binding clay on reamers when it came out
- Water ingress into the hole.
- New proposed depth of 80m posed pumping challenges because there was no pump at site with adequate capacity to pump the required volume and pressure through a head of 80m
- Experiencing downtime in mud mixing because of losses being experienced downhole.
- New drill pipes were required to replace those lost in the hole during the first drilling attempt.

Execution Strategy Adopted To Mitigate Additional Challenges

- Procured New drill pipes,
- We had 5 no Mud mixing systems at site to Increase mud-handling capacity.
- New profile is 10m deeper than previous profile with an approximate 35m of cover. These greatly reduce the risk of water ingress into the hole.
- Used new Bentonite - Gel TEQ with the following properties:

- Procured new specially reamer design (36", 42" 46" and 52"). These reamer designs are designed to handle the rock, sand, coal and clay formation.
- Secure the services of a Very Experienced Mud Engineer
- Procure mini mud lab equipment and set up a mini lab at site.

Lessons and Observations

After having the 2nd drill string stuck and having failed with all the attempts at unstocking the reamer and drill string it became obvious that we were still missing out a key challenge. Every strategy that was put in place greatly improved the drilling process yet the 2nd drill string got stuck during the 24" reaming pass. Further analysis highlighted the following:

- There are no doglegs throughout the drill path for both stuck strings.
- The 24" as well as the 42" reamers that got stuck seemed to have got stuck in the same soil section. The most likely problem seemed to be drilling fluid management issue. The area in question seemed to be mainly loose sand, just before 6m clay sections interplaying with the 1.5m thick rock tables. It was difficult to gauge the exact position as further boreholes samples were taken at 100m intervals. Hence the tendency to run into difficulties change from high viscous fluid to low viscous fluid exiting from the sand into the hard clay cum rock section.
- In order to come up with specific solution to the problem, the need arose to carry out a further soil test that will clearly mark out the exact location of the various soil strata marking out the various interface points through the drill path.
- There are too many interphases encountered at this depth. There is need to select a bore path that reduces the no of soil interphases to manage and reduce the rock section as much as possible.
- Retrieval of the 24" stuck and string may take quite a while if at all, the prospect of attempting retrieval for 2,3,4 weeks then finding out it is unsuccessful then having to start all over again would only prolong the successful execution of the project.

Peculiar Site Challenges – Attempt 3

At this point it was clear that the challenge with subject crossing is the section from the exit point to the first rock section. Careful analysis of the all the drill logs showed that the section of the ROW beyond the 1.5m flat rock coming from Pipe Side (Point B) towards Rig Side (Point A) as the drill bore goes through the rock section was very stable limiting the problem to the exit side.

Additional Site Challenges

There was need to carry out further soil test but the major challenge was determining the appropriate test for subject site condition. Further bores clearly showed that we were dealing with loose sand and the problem always occurred either just above the interface between the Very loose sand section and the hard clay/rock interface area or below it (same Soil Condition). A soil test that will clearly highlight these interphase areas became mandatory. The initial soil test had challenges, as we initially could not bore through the rock formation. Geophysical electric mapping which we then adopted also had the following challenges:

- a) The geomorphology of the area was steeply undulating with hills sharply ascending and descending respectively.
- b) Very deep man made ravines occasioned by sand winning exist on one side of the pipeline route around the valley of interest.
- c) Wire meshes were used to construct terracing down the valley from crest to crest, area of coverage of more than 2,000 m².

The aforementioned conditions posed challenges to getting enough spread length for the vertical electrical sounding. The intended perpendicular mapping of the route at intervals down slope became impossible. These conditions limited the geophysical survey.

We needed a method that will achieve the following:

- a) Characterize the subsurface based on its electrical resistivity distribution
- b) Determine the lateral variation of subsurface materials and its engineering implications.
- c) Itemize the possible reason(s) why there were losses of circulation/stuck pipes during the previous two attempts.
- d) Further shed light on possible regions that required more engineering precautions.

After extensive review of available options, it was finally determined to carrying out a further geophysical investigation using 2D and 3D Electrical Resistivity Imaging.

The report finally shed more light on the lateral variation of the sub surface materials and its engineering properties. It enabled us Map the lateral variation of the subsurface variations at the pipe side thus enabling us come up with specific solutions.

- From the interpretation and analysis of the geophysical data obtained from the site at Ekiadolor, Edo State alongside the geological and hydro-geological facts available, the following conclusions were made: -The subsurface was characterized into four main regions based on the electrical resistivity signatures. The first region comprises of Lateritic (Topsoil) Soil, the second region is composed of Sand, the third region is clay (localized in the neighborhood of the river bed) and the fourth region is the lithified sandstone region (characterized as Bedrock in the boring).
- It was observed that there are three main vertical structures along the profile (in the neighborhood of the river bed) indicative of fault in the subsurface.
 - The first fault is within the lateral distance of about 310m from the entry point. The second indicated fault is within the lateral distance of about 459m from the entry point.

- The third indicated fault is within the lateral distance of about 600m from the entry point.

The loss in circulation which aided the getting stuck of the 24" reamer and drill pipe string can be associated to the presence of the subsurface faults.
These presences of faults (opening) in the subsurface are highly inimical to drilling operations.

Execution Strategy Adopted To Mitigate Additional Challenges

Having finally determined the main cause of failures of the previous drilling attempts, we needed to adopt a strategy that would ensure success of subsequent drilling plan. A detailed strategy was developed for the phase 3 of the project taking into considerations the lessons and challenges from phases 1, and 2.

Careful review came up with the following strategy: -

Staying at the current depth of the crossing would require a huge increase in mudflow in order to create enough velocity to carry cuttings successfully to the surface for removal bearing in mind the anticipated losses that would occur as a result of the 3 No Fault Lines across the ROW. Hence the strategy was adopted to install the crossing at a high drill profile as possible to alleviate some of the fluid velocity challenges. Also raising the level of drill profile would also keep the profile out of some of the troublesome rock sections and sections with multiple mix of different soil strata. This had the advantage of making the operation more manageable. Consequently it was agreed to install the new line at a depth of 65m.

Lessons and Observations

- Drilling went very well as planned until we got to 48" reaming pass.
- 16" to 48" Reaming passes were carried out in less than 4 weeks.
- After we abandoned the installation of the 42" casing, we ran a 36" clean pass through the hole. We only encountered soil collapse within 200m from exit point where it was taking an average time of 40mins to ream a joint; thereafter it took less than 5 minutes/joint to pull the 36" reamer through the rest of the hole.

Peculiar Site Challenges – Attempt 4

Having determined that we still have a very stable 42" hole across 80% of the ROW from the rig side, the need arose to find a solution that will take advantage of the existing drilled hole rather than drill a new pilot hole. Beside there was nowhere to drill a new line on the same vertical as we have already drilled 3 different profiles on the same vertical axis.

Also, the consensus was that any new pilot hole must avoid the 145m- collapsed section. Consequently, it was decided that most option would be to install a 48" casing. Drilling a new pilot hole to intersect into the existing 42" hole was adopted as a better option than to drill a new pilot hole.

Additional Challenges

At this point the challenges has become how to install the 48" casing to perfectly align with the existing 42" hole the following options were considered:-

- Using a Ground-O-Ram hammer to hammer in the casing. 60m of casing will be required in this case. This however had a peculiar challenge that it will be installed in an angle of 14 deg to the horizontal and we have no means of marking out the exact location with a tolerance of less than 1%. It was determined that the impact of the hammer will trigger the collapse of the stable/ open section of the already reamed 42" hole. We therefore discarded this option.
- Using the combination of the 380 Ton pusher at the pipe side and 500ton drilling rig at the rig side to install the 48" casing. This would have worked perfectly except that the pusher has a clamp of 60" diameter and would require a 48" adapter. We only have a 36" adapter for pusher and would take 12 weeks according to the manufacturer (Prime Drilling) to make the adapter. This option was therefore discarded.
- The 3rd option was to install the 48" casing using a thrust bore machine. This looked plausible to first but had a challenge of being installed at an angle of 13 deg to the horizontal. Without a guide in front the nose of the pipe will drop during installation and go out of alignment with the existing hole. This option was eventually selected and the following strategy developed and implemented as articulated below.
- Also, on aborting the pullback on 10th December 2017, a new challenge surfaced when the 42" reamer stopped at the mouth of the 48" casing and couldn't come out while trying to retrieve the 42" reamer.
- On the 27th of January 2018, we ran yet into another challenge. While extracting the 48" casing and the reamer (the adopted strategy was to extract them together as part of the reamer assembly was already inside the 48" casing thereby preventing the loose cased section from collapsing on the reamer were the casing to be extracted alone) the drill string from the 500ton rig at the rig side unscrewed from the reamer. After pulling the casing and the reamer, the affected section collapsed and again we lost the hole.

Execution Strategy

- A new pilot was design to start from 145m from the 3rd existing point shown as Entry Point on Attachment A4.2. Leaving an unstable section of the ROW of 48.8m.
- The new profile was design to intersect the existing 48" hole at a point 217.74m from the Entry Point at pipe side.
- The casing installation was design to protect 72m section of the crossing profile from the new Entry Point to the intersection drill profile. Approximately 55m of casing were installed leaving 16m free space required for the thrust boring machine.
- Since the space of the pipe is 48" X 900pound/ ft thrust boring machine was chosen. This eliminated the use of adapter were the 60 X 900pound/ft Thrust boring machine were to be used.

When we encountered the challenge of the reamer hooking to the end of the casing we were faced with the following options

1st option is to well a 36" pull head behind the 60m spool attached with the pull head and pull all the way out to the rig side using the 500ton rig. This had the advantage of acting as a clean pass and in the event of coming out at the rig side will be a confirmation that the 36" pipe was good to go. Also, we could always pull the dummy back from the pipe side if we encounter a collapsed hole.

2nd option was to extract the 48" casing, pull out the pull head and reinstall the 48" casing. Reinstalling the casing ran the risk of misalignment as the head of the casing was only 20m away from the hard section and there was a risk of the case section collapsing completely and the reamer not able to find the hole.

3rd option was to extract the 48" casing, pull out the pull head and dig out the loose sand section that was cased.

We finally adopted the strategy of extracting the casing and digging out the cased section as it was clear it was going to collapse on extraction of the 48" casing See attachment P-4.12.

When the drill string unscrewed on 27th January 2018 and we lost the string connection between the rigs, we were again faced with two options as follows: -

Run a bull nose hole finder through the collapsed section to reacquire the hole, excavate out the previous cased section of the ROW 45m long, slopped to a depth of 12m or set up a complete pilot assembly and drill a pilot hole through the collapsed section and run it all the way to the exit at the rig side.

We finally adopted a strategy to run the bull nose first and in the event that did not work after 3 days abort and run the pilot hole full probe. This option was better as it was going to take 3 days to set up the pilot hole assembly.

We then commence running of bull nose while setting up the pilot hole assemble. On the 3rd day when we are not making progress reacquiring the hole with the bull nose, we commence the pilot hole drill and reacquired the hole and pushed the drill bit all the way to the 500ton rig side. We then reconnected the two rigs and were ready to go. This process also confirm to us that the rest of the hole was intact as the pilot hole readings obtained with this run was in alignment with the original pilot hole for this phase.

PULL BACK OPERATIONS VERY SUCCESSFUL

PROJECT OVERVIEW **SHORE APPROACH**

12inch x 4km Pipeline Crossing from Ango Field to Offshore Section going to Auntie Julie Platform

May 2016 saw the successful completion of Nigeria first pipeline shore approach, using Horizontal Directional Drilling Technology (HDD).

Nigeria, with its vast amount of natural reserves, has already seen the installation of many pipeline crossing by HDD. however, up till now all shore approaches had been constructed with the conventional method of “cut and cover”; digging a trench onshore and nearshore, pull the pipeline through this trench ashore and subsequently cover (protect) the pipe with back fill material such as sand and rock ; this construction method involves a large amount of marine work, mobilising expensive dredging vessels and backfill equipment, and sourcing and transportation of suitable backfill material.

Using Horizontal Directional Drilling (HDD) for the first time, the benefits were obvious: reducing the requirements for significant marine operations (dredging and backfill), and, due to the pipeline having a far larger cover under the seabed compared to a dredged trench, it will be better protected for future incidents such as dropped objects, anchor dragging, stranding /shipwrecking and acts of violence (sabotage & acts of war).

HDD-technology is not new to Nigeria; onshore pipelines have been installed for more than 15 years using HDD. However, the use of HDD to install a pipeline under the shoreline had not been done before.

After months of preparations, including geotechnical investigations, detailed design, compilation of method statements and work execution procedures, planning, coordination between the onshore HDD-contractor, pre-installation of the 12" x 1.8km Swamp Section and 12" x 2.2 km shore approach long pipestring on the seabed, mobilisation and set-up of the HDD-equipment on site, drilling of the pilot hole, reaming and cleaning the borehole to the final diameter the pipestring was pulled successfully into the borehole.



Floating of pipeline spool in ditch



Set up of equipment on barge



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Hook up of bundle line on rollers

Pullback of bundle line

PROJECT LISTING

ONGOING WORKS BY HORIZONTAL DIRECTIONAL DRILLING (HDD)								
Item	Project Description, Type of Project, Position in the Project Execution, Location	CONTRACTOR / VENDOR	Client	Commencement Date	Scheduled completion time	Status	Type of Pipe Line (Gas or Product)	Length of Pipe line (In Km.)
1	Replacement of 18" x 1.5km Gbaran Pipeline - HDD	ENIKKOM CONSTRUCTION LIMITED	NDPHC	June 2022	August 2022	Ongoing	Gas	1.5
2	Engineering, Procurement, Construction, Installation and Commissioning of 10" x 10km Product Transmission Pipeline from Utorogun – UPS by Continous Horizontal Directional Drilling Technique (CHDD) including Line Pipes Procurement, Welding Works and tie-ins at 5m-10m Depth in OML34	ENIKKOM CONSTRUCTION LIMITED	NPDC / ND WESTERN	August 2021	August 2022	Ongoing	Gas	12
3	48" Dia. x 2km Pipeline Crossing by a Combination of HDD and Microtunneling Across River Niger (OB3)	ENIKKOM CONSTRUCTION LIMITED	NNPC	Dec 2020	Dec 2022	Ongoing	Gas	2

ONGOING WORKS BY PIPELINE CONSTRUCTION								
Item	Project Description, Type of Project, Position in the Project Execution, Location	CONTRACTOR / VENDOR	Client	Commencement Date	Scheduled completion time	Status	Type of Pipe Line (Gas or Product)	Length of Pipe line (In Km.)
1	Construction, Installation, Testing & Commissioning Of Carbon Steel Pipeline. 8km x 18inch and Approx. 2km x 12Inch Pipeline	ENIKKOM CONSTRUCTION LIMITED	NIPCO	Jul 2022	Sept 2022	Ongoing	Gas	10km

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HORIZONTAL DIRECTIONAL DRILLING (HDD) WORK EXPERIENCE								
S/N	Client	General Description Project	Description of Role Played	Commencement Date	Completion Date	Pipeline Size	Installtion Distance	Trenchless Type
1	MORPOL / SPDC	Redrill of 900m X 6" Steel casing for FOC Across Orashi River by HDD	HDD Contractor	May 2022	June 2022	6-Inch	900m	
2	MORPOL / SPDC	INSTALLATION of 900m X 12" Steel Pipeline And 900m X 6" Steel casing for FOC Across Orashi River - HDD AND 400m X 12" Steel Pipeline And 400m X 6" Steel Casing Pipe for FOC Across Mbiam - Yenagoa Road and Epie Creek.	HDD Contractor	March 2021	August 2021	12-Inch	900m x2 400m x2	
3	ZAKHEM CONSTRUCTION NIERIA LIMITED / DANGOTE FERTILIZERS LIMITED	LEKKI GAS PIPELINE PROJECT (LGPP): Engineering, Procurement, Construction and Installation of 36inch (schedule 22.225) x 1.4km Gas Pipeline Across Swamp and River Using Horizontal Directional Drilling (HDD) Method at Ejirinrin, Epe, Lagos State. EPC CONTRACTOR.	HDD Contractor	Jun-2018	Oct-2018	36-Inch	1.4Km	
4	GRAMEN PETROSERVE LIMITED / CHEVRON NIGERIA LIMITED	Escravos Export System Project; Design and Installation of 30" X 540m Pipeline Section At Escravos Creek Using Horizontal Directional Drilling (HDD) Method. EPC CONTRACTOR.	HDD Contractor	Dec-2017	Jan-2018	30-Inch	540m	
5	GREEN GAS LIMITED / NIPCO PLC	CONSTRUCTION, INSTALLATION AND TESTING OF 12" x 11.6km PIPELINE (Phase - 1) <u>including 5.6km of installation using HDD</u> (12" x 1.7km; 12" x 900m; 12" x 1.25km; 12" x 700m; 12" x 580m; 12" x 470m) ALONG IBADAN EXPRESS WAY	HDD Contractor	Apr-14	Jun-16	12-Inch	11.6Km	
6	ZAKHEM CONSTRUCTION NIERIA LIMITED	Expansion Of Escravos-Lagos Gas Pipeline Project – Phase II For The Construction, Installation And Testing Of 36inch X 15km Pipeline By Horizontal Directional Drilling (HDD) with <u>5.33km of Continous HDD Section - 2.78km; 550m and 2km sections.</u>	HDD Contractor	Feb-14	Dec-15	36-Inch	15Km	
7	MSI AFRICA DEVELOPMENT LIMITED	Installation of 12inch x 4km Pipeline Crossing from Ango Field to Offshore Section going to Auntie Julie Platform <u>(12" x 1.8km Swamp Section by HDD and 12" x 2.2 km shore approach by HDD)</u> . The line is for the provision of Hydrocarbon Evacuation Pipeline from the Ango Reservoir in OML-59 to Auntie Julie Production Facility BELBOP NIGERIA LIMITED.	HDD Contractor	Aug-13	May-16	12-Inch	1.8Km	

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8	KAZTEC ENGINEERING LIMITED / PIPELINES AND PRODUCTS MARKETING COMPANY LIMITED (PPMC)	Emergency Reconstruction Of Atlas Cove – Mosimi 16" X 1800m Pipeline Section At Ijedodo Swamp Using Horizontal Directional Drilling (HDD) Method. EPC CONTRACTOR.	HDD Contractor	May-13	Mar-14	16-Inch	1800m	
9	PIPELINES AND PRODUCTS MARKETING COMPANY LIMITED (PPMC)	Emergency Reconstruction Of Atlas Cove – Mosimi 16" X 3000m Pipeline Section At Arepo Swamp Using Horizontal Directional Drilling (HDD) Method. EPC CONTRACTOR.	HDD Contractor	Dec-13	Dec-14	16-Inch	3000m	
10	SAIPEM CONTRACTING NIGERIA LIMITED	HDD for Escravos River Crossing: Otumara Project: Construction Of 12" X 2.737km Pipeline To Cross The Escravos River Using The Horizontal Directional Drilling (HDD) Method for SAIPEM CONTRACTING NIGERIA LIMITED. Main Client is SPDC. EPC CONTRACTOR.	HDD Contractor	Apr-14	Feb-16	12-Inch	2.737Km	
11	ZAKHEM CONSTRUCTION NIGERIA LIMITED	Expansion of Escravos-Lagos Gas Pipeline Project-Phase I. Construction, Installation and Testing of 30inch x 395m Gas Pipeline across the Benin-Warri Expressway Using the Horizontal Directional Drilling (HDD) Technology for ZAKHEM. Main Client is NIGERIAN GAS COMPANY LIMITED (NGC). EPC CONTRACTOR.	HDD Contractor	Jan-12	Apr-12	30-Inch	395m	
12	APAPA SPM LIMITED / OANDO PLC	Engineering, Procurement, Construction and Commissioning of (16", 6" and 4" x 700m single Boundle Pull) Products Pipelines from Alakpata Facility to Marina Floating Jetty of the Phase I Apapa Oando Jetty Project : Offshore Pipeline Construction From New Jetty To Alapata Facilities Using The Horizontal Directional Drilling (Hdd) Method. EPCC CONTRACTOR.	HDD Contractor	Nov-11	Mar-14	16-Inch,6-Inch, 4-Inch	700m	
13	COMPACT MANIFOLD AND ENERGY SERVICES LIMITED (CMES)	Construction / Laying and Commissioning of 5 River Crossings on the 54km by 24inch Gas Transmission Pipeline from Adanga to Calabar in Cross River State (Onshore Part of the Lot3) by Horizontal Directional Drilling viz; Calabar River - 680m, Uruan River - 739m, Akwua River - 897m, Qua River - 759m and Oron River - 1862m. EPCC CONTRACTOR.	HDD Contractor	Oct-11	Dec-13	24-Inch	54Km	
14	OILSERV LIMITED	Construction and Installation of 12" x 300m Gas Pipeline by Horizontal Directional Drilling across the Liverpool River for the Entire Pipeline Crossing of liverpool River for the OANDO Pipeline Works. EPC CONTRACTOR.	HDD Contractor	Sep-11	Oct-11	12-Inch	300m	

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15	NIGER DELTA PETROLEUM RESOURCES	Construction and Installation of 12" x 300m Gas Pipeline by Horizontal Directional Drilling across the Sambreiro River at Rumuji for the Ogbele-Rumuji Pipeline Project. EPC CONTRACTOR.	HDD Contractor	Jun-10	Jul-10	12-Inch	300m	
16	OILSERV LIMITED	Complete Installation of 7 No River Crossings using the Horizontal Directional Drilling Method HDD on the 18inch by 130km Calabar Pipeline Project. (12" x 1.302km; 12" x 485m; 12" x 472m; 12" x 875m; 12" x 363m; 12" x 704m; 12" x 760m)	HDD Contractor	Aug-09	Dec-10	18-inch	130Km	
17	OILSERV LIMITED	Construction and Installation of 12"x 195m Gas Pipeline across the Coconut River in Lagos for the 12inch Gas Pipeline Construction that Stretches Out From Honeywell Tin-Can to Amuwo Odofin (Gaslink Phase II Project) Lagos State. EPC CONTRACTOR.	HDD Contractor	Feb-09	Mar-09	12-Inch	195m	
18	OILSERV LIMITED	Installation of 18" x 250m Iju River Crossing at the Akute Power Project Using Horizontal Directional Drilling Technology	HDD Contractor	Mar-09	Apr-09	18-inch	250m	
19	NIPCO PLC	Installation of 50km x 4", 6" and 8" diameter Gas Distribution Pipeline System within Benin City with over 20km of Installation done by HDD	HDD Contractor	Apr-08	Apr-10	4-Inch,6-Inch,8-Inch	20Km	
20	INTRINSIC NIGERIA LIMITED	INSTALLATION OF A 24INCH X 1.4KM GAS PIPELINE ACROSS THE NIGER RIVER AT NDONI (EPC FOR PIPELINE 24", 18" AND 10" N-LNG PHASE 3 GAS SUPPLY PROJECT). Subcontract from Intrinsic Nigeria Limited with DAEWOO/NAOC as MAIN CLIENT.	HDD Contractor	Dec-03	Apr-04	24-Inch, 18-Inch, 10-Inch	1.4Km	

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CONVENTIONAL (OPEN CUT) PIPELINE WORK EXPERIENCE							
S/N	Client	General Description Project	Description of Role Played	Commencement Date	Completion Date	Pipeline Size	Installtion Distance
1	LAGOS STATE MINISTRY OF WORKS & INFRASTRUCTURE (LSMW&I) / PPMC	Relocation of NNPC Atlas Cove - Mosimi 16" Pipeline Segment Located Along the Alignment of the Lagos-Badagry Carriageway Expansion Project; 16" x 1,800m Pipeline Construction by Open Cut and 16" x 220m Pipeline Construction by HDD.	Pipeline Contractor	Feb-14	May-15	16-Inch	1.8km
2	NIPCO PLC	Construction, Testing and Commissioning of 12", 8" & 4" Underground Steel Pipeline Laying Work & Above Ground Piping Work at Ibafo Area (Lagos-Ibadan Expressway), Ogun State. Reference No.: NIPCO/GGL/CNG/IBAFO/PL/09-13 (WO).	Pipeline Contractor	Feb-14	Jul-16	12-Inch, 8-Inch, 4-Inch	
3	KAZTEC ENGINEERING LIMITED	Onshore Engineering, Procurement and Construction Contract of 30" x 12.5km Product Pipeline for the Trans Niger Pipeline Loopline Project (TNPL) - Package 1, From Ogale To TP1 at Eleme in River State. Main Client is Shell Petroleum Development Company Nigeria Limited (SPDC) & Main Contract No. is NG01010061.	Pipeline Contractor	Aug-13	Nov-14	30-Inch	12.5Km
4	NIGER DELTA POWER HOLDING COMPANY LIMITED (NDPHC)	Engineering, Procurement and Construction for 24" x 51km Gas Transmission Pipeline and Metering Station at Calabar in Cross River State (Onshore Part of the Lot 3). Main Client- Niger Delta Power Holding Company (NDPHC).	Pipeline Contractor	Apr-12	Dec-13	24-Inch	51Km

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5	NIGERIAN GAS COMPANY LIMITED (NGC)	Engineering, Procurement and Construction (EPC) of Gas Supply Infrastructure (6" x 0.034km; Pressure Reduction and Gas Metering Facilities) to Standard Metallurgical Company Limited (SMCL), JV Contract itn of Petrotrans-Enikkom JV Limited, Main Client-Nigerian Gas Company.	Pipeline Contractor	Apr-12	Aug-12	6-Inch	0.034Km
6	ZAKHEM CONSTRUCTION NIERIA LIMITED	Expansion of Escravos-Lagos Gas Pipeline Project-Phase I. Construction, Installation and Testing of 30" Pipeline Segment by Thrust Boring Method under Road Between Warri to Oben for ZAKHEM. Main Client is NIGERIAN GAS COMPANY LIMITED (NGC)	Pipeline Contractor	Sep-11	Apr-12	30-Inch	
7	ZAKHEM CONSTRUCTION NIERIA LIMITED	Construction of 24" x 18km and 16" x 16.5km Gas Pipeline from Itoro to Ibeshi. Subcontract from ZAKHEM. Contractor ENIKKOM/GEN OIL.	Pipeline Contractor	Sep-10	Apr-11	16-Inch	16.5Km
8	NIPCO PLC	Laying, Testing and Commissioning of 8" & 4" (Dia) Steel Gas pipeline for NIPCO Benin City Gas Distribution Project (2nd Phase)	Pipeline Contractor	Aug-10	May-11	8-Inch & 4-Inch	
9	ZAKHEM CONSTRUCTION NIERIA LIMITED	Emergency Sectional Rehabilitation/Replacement of the 16" diameter Atlas Cove – Mossimi Pipeline. Main Client of NNPC and Subcontract from ZAKHEM.	Pipeline Contractor	Jul-10	Nov-10	16-Inch	
10	OILSERV LIMITED	Construction of 18" x 1.5km Gas Pipeline at Gbaran Ubie NIPP Lot 2 Project.	Pipeline Contractor	Jan-10	Apr-10	18-Inch	1.5Km
11	OILSERV LIMITED	Construction of 18" x 2.5km and 16" x 16.5km Gas pipeline that Transverses from NPDC Oredo Facility to POOC Gas Station, all Gas Pipelines Located in Edo State, including Road Crossings by Thrust Boring.	Pipeline Contractor	Mar-09	Mar-10	18-inch, 16-Inch	2.5Km, 16.5Km

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12	NIGER DELTA PETROLEUM RESOURCES	Installation of 12" x 13.8km Ogbele-Rumuji Pipeline Project, including the Sambreiro River Crossing by Horizontal Directional Drilling	Pipeline Contractor	Jul-09	Apr-10	12-Inch	13.8Km
13	OILSERV LIMITED	Drilling and Blasting Services at Mfamosing Rock Section (UNICEM Project)	Pipeline Contractor	Jul-09	Sep-10		
14	OILSERV LIMITED	Additional Works on the 18inch Calabar Gas Pipeline to include Bush Clearing, Excavation and Stringing	Pipeline Contractor	Jan-09	Sep-09	18-Inch	
15	OILSERV LIMITED	Complete Drilling and Blasting of Three (3) km pipeline ditch	Pipeline Contractor	Dec-08	Feb-09		3Km
16	NIPCO PLC	Laying, Testing and Commissioning of 8" & 4" (Dia) Steel Gas pipeline for NIPCO Benin City Gas Distribution Project (1st Phase)	Pipeline Contractor	Oct-08	Dec-09	8-Inch & 4-Inch	
17	OILSERV LIMITED	Construction of 12-Inch Gas Pipeline that Stretches Out From Honeywell Tin-Can to Amuwo Odofin (Gaslink Phase II Project) Lagos State, including 2Nos crossings by Horizontal Directional Drilling across the Coconut River.	Pipeline Contractor	May-08	Dec-08	12-Inch	
18	OILSERV LIMITED	Pipe Lay and Weld for the Construction of Transmission Pipeline from Ukanafun in Akwa Ibom State to Mfamosing in Cross river State for Land, River Crossings, Road Crossings, Seasonal Swamp / Rocky and Hilly Terrains.	Pipeline Contractor	Mar-08	Dec-10		
19	ZAKHEM CONSTRUCTION NIERIA LIMITED	36" Geregu Gas Supply Pipeline Project: Nigerian Gas Company Limited: Sub Contract for the Welding Works on a part of 36" gas pipeline (approximately 50km – 4300 joints) of 196km on Gas Supply to Geregu project.	Pipeline Contractor	Mar-08	Oct-09	36-Inch	

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20	ZAKHEM CONSTRUCTION NIERIA LIMITED	Abeokuta Gas Pipeline: Sub Contract for the Transportation Of 3,100pcs of 24" diameter line pipes from Tin-Can Island to Abeokuta, Stringing of line pipes along the ROW, welding of line pipes and tie in of welded pipeline sections, Radiography and field works	Pipeline Contractor	Sep-07	Feb-08	24-Inch	
21	ZAKHEM CONSTRUCTION NIERIA LIMITED	Installation Gas Plant facilities and welding/fabrication of interconnecting pipework.	Pipeline Contractor	Sep-07	Dec-08		
22	ZAKHEM CONSTRUCTION NIERIA LIMITED	Sub contract for Civil and Foundation works for the Abeokuta Gas plant	Pipeline Contractor	Jul-07	Dec-07		
23	ZAKHEM CONSTRUCTION NIERIA LIMITED	Call off Contract, Geregu Gas Pipeline Project Phase II (NGC Limited). Sub-contract for Road, Rail and Thrust Bored Crossings (2No Rail Crossings and 11No Road Crossings – 36" diameter pipeline)	Pipeline Contractor	Jun-07	Dec-08	36-Inch	
24	ZAKHEM CONSTRUCTION NIERIA LIMITED	Rehabilitation/Replacement of corroded swamp sections of the 16" diameter Atlas Cove – Mossimi Pipeline by the push pull flotation method, flushing of the entire 70km pipeline and tie-in of the replaced sections to the main line (Akute – 3.5km; Arepo – 2k)	Pipeline Contractor	Jan-07	Jun-07	16-Inch	70Km
25	TVONNE NIGERIA LIMITED	Installation of 4No. 18" Pipeline Road Crossing by Thrust Boring Method at Bonny Island, including construction of Cofferdam.	Pipeline Contractor	Mar-06	May-06	18-Inch	

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26	WILLBROS WEST AFRICA, INC	Procurement and Installation/extraction of Sheet Piles for the Construction of Cofferdam for thrust boring works, including the Thrust Boring of the TSKJ and NLNG Roads on Bonny Island, Thrust Boring Of TSKG Roads	Pipeline Contractor	Aug-05	Sep-05		
27	ZAKHEM CONSTRUCTION NIERIA LIMITED	Ajaokuta Pipeline Project: Sub Contract for the Stringing of 18inch x 50km line pipes along the ROW, Excavation, Welding of line pipes, Laying and Backfilling of Welded Pipeline for the Dangote – Obajana Cement Factory.	Pipeline Contractor	Sep-05	Jul-06	18-Inch	50Km

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THRUST (AUGER) BORING PIPELINE WORK EXPERIENCE							
S/N	Client	General Description Project	Description of Role Played	Commencement Date	Completion Date	Pipeline Size	Installtion Distance
1	ZAKHEM CONSTRUCTION NIERIA LIMITED	Expansion of Escravos-Lagos Gas Pipeline Project-Phase II. Construction, Installation and Testing of 36" Pipeline Crossings from KP 294+000 to KP 333_300 by Thrust Boring Method under Road Between Lagos and Ogun States. Main Client is NIGERIAN NATIONAL PETROLEUM CORPORATION (NNPC)	Thrust Boring Contractor	Feb-13	Dec-13	36-Inch	
2	ZAKHEM CONSTRUCTION NIERIA LIMITED	Expansion of Escravos-Lagos Gas Pipeline Project-Phase I. Construction, Installation and Testing of 30" Pipeline Segment by Thrust Boring Method under Road Between Warri to Oben for ZAKHEM. Main Client is NIGERIAN GAS COMPANY LIMITED (NGC)	Thrust Boring Contractor	Sep-11	Apr-11	30-Inch	
3	ZAKHEM CONSTRUCTION NIERIA LIMITED	Thrust Boring Under Sewerage Line Crossings at Tema in Ghana for the WEST AFRICAN GAS PIPELINE Project	Thrust Boring Contractor	Apr-09	May-09		
4	ZAKHEM CONSTRUCTION NIERIA LIMITED	Call off Contract, Geregu Gas Pipeline Project Phase II (NGC Limited). Sub-contract for Road, Rail and Thrust Bored Crossings (2No Rail Crossings and 11No Road Crossings – 36" diameter pipeline)	Thrust Boring Contractor	Jun-08	Dec-08	36-Inch	
5	TVONNE NIGERIA LIMITED	Installation of 4No. 18" Pipeline Road Crossing by Thrust Boring Method at Bonny Island, including construction of Coffer Dam.	Thrust Boring Contractor	Mar-07	May-07	18-Inch	
6	WILLBROS WEST AFRICA, INC	Procurement and Installation/extraction of Sheet Piles for the Construction of Cofferdam for thrust boring works, including the Thrust Boring of the	Thrust Boring Contractor	Aug-06	Sep-06		

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		TSKJ and NLNG Roads on Bonny Island, Thrust Boring Of TSKG Roads					
7	INTRINSIC OIL & GAS LIMITED	Thrust Boring of the TSKJ and NLNG Roads on Bonny Island (36" Crossing)	Thrust Boring Contractor	Aug-06	Sep-06		
8	WILLBROS WEST AFRICA, INC.	Procurement and Installation/extraction of Sheet Piles for the Construction of Cofferdam for thrust boring works, including the Thrust Boring of the TSKJ and NLNG Roads on Bonny Island, Thrust Boring Of TSKG Roads	Thrust Boring Contractor	Aug-06	Sep-06		
9	WILLBROS WEST AFRICA, INC.	Installation of Sheet Pile for the 48/32" Shell Pipe Crossing by Thrust Boring on Bonny Island (Additional 32m)	Thrust Boring Contractor	Sep-06	Oct-06	48/32-Inch	32m
10	WILLBROS WEST AFRICA, INC.	Supply of Sheet Pile for the 48/32" Shell Pipeline Crossing by Thrust Boring on Bonny Island.	Thrust Boring Contractor	Jun-06	Aug-06	48/32-Inch	
11	WILLBROS WEST AFRICA, INC.	Installation of Sheet Pile for the 48/32" Shell Pipeline Crossing by Thrust Boring on Bonny Island.	Thrust Boring Contractor	Jun-06	Aug-06	48/32-Inch	

3 – PROJECT & EXPERIENCE

DREDGING WORK EXPERIENCE						
S/N	Client	General Description Project	Description of Role Played	Commencement Date	Completion Date	
1	MSI AFRICA	Maintenance Dredging and Expansion in Obodo Field (OML-150) to Accommodate Drilling Rig Access to Oil Wells for CONOIL (Continental Oil & Gas) In Delta State	Dredging Contractor	Contractor	2018	
2	MSI AFRICA	Dredging/Expansion of Ekekhor Slot In Delta State	Dredging Contractor	Contractor	2016	
3	WEST AFRICAN OILFIELD SERVICES (WAOS)	Dredging of Swamp Locations in Ekoko for Slot Expansion to Accommodate Drilling Rig Access to Oil Wells – OPL 2007 (CON-FTS-SP-04) for CONOIL (Continental Oil & Gas).	Dredging Contractor	Contractor	2014	
4	KAZTEC ENGINEERING LIMITED	Dredging, Sandwining and Sandfilling of Snake Island, Lagos State for the New Jetty Construction for Addax Petroleum Nigeria Limited.	Dredging Contractor	Contractor	2012	
5	AZIKEL NIGERIA LIMITED	Dredging, Sandwining and Stockpiling of 200,000m3 of Sharp Sand for AZIKEL Nigeria Limited at Ogbigoro, Bayelsa State.	Dredging Contractor	Contractor	2012	
6	B+G&S NIGERIA LIMITED	Dredging, Sandwining and Stockpiling of 50,000m3 of Sharp Sand for the DAEWOO/NAOC Life Camp on the Agip Gas Plant Extension Project at Ogbembiri, Bayelsa State. Subcontract from B+G&S Nigeria Limited.	Dredging Contractor	Contractor	2012	
7	JDP CONSTRUCTION NIGERIA LIMITED	Dredging, Sandwining and Stockpiling of 500,000m3 of Sharp Sand to JDP Construction Nigeria Limited for the Rivers State Government Bridge Project from Woji to Trans Amadi Industrial Layout in Port Harcourt	Dredging Contractor	Contractor	2011	

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8	WEST AFRICAN OILFIELD SERVICES (WAOS)	Dredging of Swamp Locations in OML's 59, 103 & OPL 2007. Contract BEL/WAOS/01/11.	Dredging Contractor	Contractor	2011		
9	SELTEX OIL & GAS SERVICES NIGERIA LIMITED	Dredging, Sandwining and Supply of 1,000,000m ³ of Sharp Sand to Seltex Oil & Gas Services Limited/Raffoul Nigeria Limited for the Rivers State Government Road Project in Woji, Port Harcourt	Dredging Contractor	Contractor	2011		
10	ZAKHEM CONSTRUCTION NIGERIA LIMITED	Dredging and Sandwinning for Construction of Seaport in Cotonou	Dredging Contractor	Contractor	2010		
11	AKPOS MARINE LIMITED	Construction of Loading/Landing Jetty at Abuloma, Port Harcourt.	Dredging Contractor	Contractor	2010		
12	SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED	Dredging of Various SPDC locations within the SPDC Eastern and Western Locations	Dredging Contractor	Contractor	2010		

Relevant Plant, Equipment & Facilities

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1.0 HDD & THRUST BORING EQUIPMENT

ENIKKOM, owns 9Nos. HDD Rigs, 4Nos. Thrust Boring Machine, 1No. Pusher and Other Underground / Down Hole Tools and Accessories. These equipment and machinery are located in-country in Nigeria and will be readily available for this work.

These equipment and machinery are as listed below:

S/N	DESCRIPTION	MAKE	CAPACITY	YR OF PURC.	QTY
• HDD DRILLING RIGS					
1	DD 580 HDD RIG	American Augers	300 Tons Pullback	2000	1-Nos
2	ASTEC 3238 HDD RIG	American Augers	15 Tons Pullback	2008	1-Nos
3	DD 440T HDD RIG	American Augers	200 Tons Pullback	2008	1-Nos
4	DD 1100 HDD RIG	American Augers	500 Tons Pullback	2012	1-Nos
5	DD 1100 HDD RIG	American Augers	500 Tons Pullback	2012	1-Nos
6	DD 625 HDD RIG	American Augers	300 Tons Pullback	2012	1-Nos
7	DD 220T HDD RIG	American Augers	100 Tons Pullback	2012	1-Nos
8	DD1100 HDD RIG	American Augers	500 Tons Pullback	2013	1-Nos
9	DD 150 HDD RIG	American Augers	70 Tons Pullback	2013	1-Nos
• THRUST BORING MACHINES & ACCESSORIES					
1	72–1200 NG Thrust Boring Machine	American Augers	1.2m Pound	2013	1-Nos
2	48/54–G900 Thrust Boring Machine	American Augers	900,000 Pound	2010	1-Nos
3	36 – 340 Thrust Boring Machine	American Augers	340,000 Pound	2008	1-Nos
4	24 - 100 Thrust Boring Machine	American Augers	100,000 Pound	2004	1-Nos
• MICRO TUNNELING & PIPE PUSHER EQUIPMENT					
1	800t Micro tunneling Equipment	MTS	800t	2021	1-Nos
2	380 Ton Pipe Pusher – Prime Drilling	Prime Drilling	36" – 60"x380Tons	2015	1-Nos
• DRILL PIPES					
1	5" DRILL PIPES	JAPAN		2010	Various
2	6-5/8" DRILL PIPES-25lb/ft	AMERICAN	S-135	2013	Various
3	6-5/8" DRILL PIPES - 27lb/ft	JAPAN	S-135	2013	Various
4	6-5/8" DRILL PIPES-35lb/ft	China	S-135	2021	Various
• SPECIALIZED EQUIPMENT					
1	THUMPER	TT TECHNOLOGIES	24"	2013	1-Nos
2	THRUSTER 24"-48"	PRIME	24-48"	2013	1-Nos
3	MOBILE BREAKOUT UNIT	HERENKENETT	4-1/2 TO 6-5/8	1013	1-Nos
• MUD MIXING, CLEANING & RECYCLING SYSTEMS					
1	Mud Mixing Unit	Juesco	MMU	2016	5-Nos
2	Mud Cleaning & Recycling System (MCR-10000)	A/Augers	MCR10000	2014	2 Nos
3	Mud Processing and Recycling (MPR 6000)	A/Augers	MPR6000	2014	2 Nos
4	Mud Cleaning & Mixing Unit (MCM 4000)	A/Auger	MCM 4000	2013	2 Nos
5	Mud Cleaning Technology (MCT 2000)	A/Auger	MCT2000	2013	1 Nos
6	Mud Cleaning System (MCS 750)	A/Auger	MCS750		1Nos
• MUD PUMPS					
1	Mud Pump (P-600)	A/Auger	Tri-plex 600GPM	2013	2Nos
2	Mud Pump (P-750)	A/Auger	Quintiplex, 750GPM	2013	1Nos

S/N	DESCRIPTION	MAKE	CAPACITY	YR OF PURC.	QTTY
3	Mud Pump	A/Auger (Kerr Pump)			1 Nos
4	Hydraulic Mud Pump	Herrenknecht		2015	1 Nos
5	Mud Pump	John Deere		2013	1 Nos
2	FRAC TANKS	MUD TECHNOLOGIES	500 BARREL	2012	4 Nos
• REAMERS AND SUBS					
1	BR 6 5/8" FH (18", 24", 30", 36", 42", 48" & 54")	INROCK	18" - 54"	2010	Various
2	FC 6 5/8" FH (18", 24", 30", 36", 42", 48" & 54")	INROCK	18" - 54"	2013	Various
3	BR 4-1/2" IF (18", 24", 30", 36", 42", 48" & 54")	INROCK	18" - 54"	2009	Various
4	FC 4-1/2" IF (18", 24", 30", 36", 42", 48" & 54")	INROCK	18" - 54"	2010	Various
5	XO SUBS	INROCK	4-1/2" & 6-5/8"	2010-13	Various
6	SAVER SUBS	INROCK	4-1/2" & 6-5/8"	2010-13	Various
7	WEEPER SUBS	INROCK	4-1/2" & 6-5/8"	2010-13	Various
8	ORIENTATION SUBS	INROCK	4-1/2" & 6-5/8"	2010-13	Various
9	BENT SUB	INROCK	1 DEG TO 2DEG	2010-13	Various
• PIPE ROLLERS					
1	20Ton 12"to 48" Pipe Rollers	TRENCHLESS	10T	2013	Various
2	15 Ton 12" - 48" Pipe Rollers	TRENCHLESS	15T	2011	Various
3	10 Ton 12" - 48" Pipe Rollers	LJ WELDING	20T	2010	Various
• ROLLER CRADDLES					
1	24" ROLLER CRADDLES	LJ WELDING	24"	2012	Various
2	36" ROLLER CRADDLES	LJ WELDING	36"	2013	Various
3	48" ROLLER CRADDLES	LJ WELDING	48"	2010	Various
• OTHER DOWNHOLE TOOLS					
1	8" MONEL C/W DOWN HOLE ASSEMBLY	INROCK	8"	2012	Owned
2	6" MONEL C/W DOWN HOLE ASSEMBLY	INROCK	6"	2012	Owned

2.0 OTHER CONSTRUCTION EQUIPMENT & MACHINERY

ITEM	DESCRIPTION & MAKE	CONDITION	OWNED / LEASED	QTY
PILING EQUIPMENT				
1	ABI 90-TON TRACK VIBRATORY PILING HAMMER	GOOD	OWNED	2
2	ICE 3117 VIBRO HAMMER & POWER PACK	GOOD	OWNED	1
EXCAVATORS				
1	CAT 320CL EXCAVATOR	GOOD	OWNED	Various
2	CAT 330CL EXCAVATOR	GOOD	OWNED	Various
3	CAT 330DL EXCAVATOR	GOOD	OWNED	Various

ITEM	DESCRIPTION & MAKE	CONDITION	OWNED / LEASED	QTY
4	CAT 325CL EXCAVATOR	GOOD	OWNED	Various
SWAMP BUGGY				
1	WILCO SWAMP BUGGY	GOOD	OWNED	6
BULLDOZER & PAIL LOADER				
1	DOZER D7R, D6H	GOOD	OWNED	3
2	PAIL LOADER 966 CAT	GOOD	OWNED	3
3	WHEEL LOADER 950 CAT	GOOD	OWNED	2
4	CAT 750 GRADER / RIPPER	GOOD	OWNED	2
SIDE BOOMS				
10	SIDE BOOMS – 40T	GOOD	OWNED	6
11	SIDE BOOMS – 35T	GOOD	OWNED	4
COMPRESSOR				
15	COMPRESSORS – INGERSOLL RAND	GOOD	OWNED	10
GENERATOR				
16	GENERATORS (20KVA – 500KVA)	GOOD	OWNED	Various
WELDING MACHINE & ACCESSORIES				
1	BENDING MACHINE – 16" TO 24" CRC EVANS	GOOD	OWNED	1
2	WELDING MACHINE – LINCOLN 450V (MANUAL AND ARC)	GOOD	OWNED	24
3	GRINDING MACHINE	GOOD	OWNED	6
CRANES				
1	CRANE (TELESCOPIC TYPE) – 10 TONS	GOOD	OWNED	2
2	CRANE (TELESCOPIC TYPE) – 25 TONS	GOOD	OWNED	2
3	CRANE (TELESCOPIC TYPE) – 30 TONS	GOOD	OWNED	3
TRUCKS				
1	FLAT BED TRAILERS (DOUBLE AXLE) – MACK	GOOD	OWNED	16
2	FLAT BED TRAILERS (4 X 4) – MECERDES BENZ	GOOD	OWNED	14
3	LOW BED TRAILER (4 X 4) – MECERDES BENZ – 45 TONS	GOOD	OWNED	2
4	LOW BED TRAILER (4 X 4) – 70-80 TONS	GOOD	OWNED	2
5	SALVAGE TRUCKS (MACK) – DOUBLE AXLE	GOOD	OWNED	1
6	OIL & LUBE TRUCK	GOOD	OWNED	2
7	DIESEL TRUCK	GOOD	OWNED	2
8	WATER TANKER – 3000 LITERS	GOOD	OWNED	2
9	SELF LOADER – 10 TON LIFTING CAPACITY (DOUBLE AXLE)	GOOD	OWNED	1
10	SELF LOADER – 7 TON LIFTING CAPACITY (DOUBLE AXLE)	GOOD	OWNED	1
11	DAF 1800, 4 X 4 WHEEL DRIVE BUS	GOOD	OWNED	4
12	UNIMOG 1300, 4 X 4 WHEEL DRIVE BUS	GOOD	OWNED	4
LIGHT VEHICLES				
1	TOYOTA HIACE BUS – 18 SEATER	GOOD	OWNED	12
2	TOYOTA HILUX PICK-UP – 4 X 4 WHEEL DRIVE	GOOD	OWNED	8
3	TOYOTA LAND CRUISER, HARD BACK 4 X 4 WHEEL DRIVE FIELD TRUCK (COVERED)	GOOD	OWNED	4
4	TOYOTA PRADO 4 X 4 WHEEL DRIVE	GOOD	OWNED	5
5	MEDIVAC VAN – MERCEDES G40	GOOD	OWNED	2

ITEM	DESCRIPTION & MAKE	CONDITION	OWNED / LEASED	QTY
DREDGING & MARINE EQUIPMENT				
1	MV Donaux	GOOD	OWNED	1
2	ENIKKOM ELICOTT DRAGON DREDGER, SERIES 1170-50 (CUTTER SUCTION) 16"/16" – MV KENENNA	GOOD	OWNED	1
3	ENIKKOM ELICOTT DREDGER, SERIES 670-42 (CUTTER SUCTION) 14"/14" – MV KECHIKEMDI	GOOD	OWNED	1
4	SWAMP BUGGY EXCAVATOR WITH CAT 320 BACK HOE	GOOD	OWNED	6

DETAILED SPECIFICATIONS OF HDD RIGS AND EQUIPMENT OWNED BY HDD THAILAND – ENIKKOM LIMITED

AMERICAN AUGERS DD 580, 300 TON PULL BACK CAPACITY HDD RIG



- 580,000 lb (300 tonnes) of thrust/pullback power
- 58,000 ft-lb (88,000 Nm) of rotary torque easily turns large reamers in long bores 900 hp (582 kW) Caterpillar® diesel power
- 3.75 inch (95mm) fluid course permits flow up to 850 gpm (3,200 liters/min)
- Floating Spindle™ allows simple, reliable makeup and breakout
- Pipe Hog™ triple jaw wrenches travel for precise alignment to pipe joints
- Quik Change Die Holders™
- Wiggle Steer™
- Factory direct service for fast support by knowledgeable technicians
- ES!LOK® exit-side lock out
- Rack & pinion four (4) pinion drive with adjustable force limiter
- Wireline commutator for speedy hookup of wireline guidance equipment with terminals at driller's console
- Independent controls and hydraulic circuits for thrust/pullback, torque and auxiliary operations permits simultaneous full power operation
- Driller's cabin with heat and air conditioning

ASTEC 3238, 15 ton Pull Back Capacity HDD Rig



ENGINE

- John Deere® 4045T Diesel I
- Rating 125 hp (93.2 kW)
- Other features: Quiet-Pak® Sound reduction system is standard.

Rotary DRIVE

- Rotary system Pinion and gear drive, infinitely variable speed & torque Rotary (high torque 3,800 ft-lb (5,152 Nm))
- Maximum rotary speed 225 rpm
- Fluid course.0.812 in. diameter

Carriage DRIVE

- Maximum thrust/pullback.32,000 lbs (14.5 Tonnes)

Drill angle

- 15.5°/27% grade

DRILLING FLUID PUMP

- Tplex pump Output 0-47 gpm (178 L/min)
- Maximum pressure 1,500 psi
- Carriage speed Up to 120 ft/min (36.6 m/min)
- PIPE Loader State-of-the-art rod loader uses 10 ft (3.05m) drill stem. Total pipe capacity is 500 ft (152.4 m).
- Rod Length 10 ft (3,048 mm)
- Outside diameter (tube)2.375 in (60.5 mm)
- Tool joint O.D2.625 in (66.5 mm)
- Fluid Course 1.875 in (48 mm)

American Augers DD 440T, 200 Ton Pull Back Capacity HDD Rig



- Engine: Cummins QSX15 Tier 4 final or Tier 3 (depending on country of purchase) Diesel
- Rating: 600 HP (447 kW)
- Fuel Capacity: 160 U.S. Gallons (605 L)
- Hydraulic Capacity: 200 U.S. Gallons (757 L)
- Battery: (2) Deka 908DMF 12 V, 1450 CCA

Carriage System

- **Maximum Thrust/Pullback** 440,000 lbs. (200 Tonnes)
- **Carriage System** 440,000 lbs. (200 Tonnes)
- **Maximum Carriage Speed** 95 ft. (29 m)/minute
- **Carriage Motors** (2) Hydraulic 1017 cc, Variable Displacement
- **Carriage Gearbox** (2) Planetary Drives

Rotary Drive

- **Rotary System** (3) Pinion & Gear Drive with Infinitely Variable Torque
- **Maximum Rotary Torque** 60,000 ft-lbs. (80,000 Nm) @ 0 – 25 RPM
- **Maximum Rotary Speed** 97 RPM
- **Rotary Motors** (3) 160cc Hydraulic Axial Piston/Variable Displacement
- **Rotary Brakes** (2) Spring Applied/Hydraulic Release
- **Fluid Course** 3.5 in. (88.9 mm)
- **Mud Flow Rate** Permits up to 825 U.S. Gallons /minute
- **Maximum Mud Pressure** 1,500 psi (103.4 bar)
- **Mud Swivel** Rear Mounted, 5 in. (127 mm) IFLH Pin

Drill Rig

- **Drill Angle** 10° - 18°
- **Drill Pipe Range** II – 34 ft. (10.4 m)

Transport Dimensions

- **Transport Dimensions** 50 ft. 9in. (15.47 m)
- **Width** 8 ft. 2 in. (2.51 m)
- **Height** 11 ft. 10 in. (3.61 m)

Transport Weights

- **Total Weight** 98,060 lbs. (44,479 kg)
- **Total Weight w/o Wrench** 90,260 lbs. (40,941 kg) – Wrench is Removable for Lighter Transport

AMERICAN AUGERS DD 1100, 500 TON PULL BACK CAPACITY HDD RIG



DD1100 HDD RIG



DD1100 HDD POWER PACKS

- ENGINE: Caterpillar C -18 Tier 4 final or Tier 3 Diesel (depending on country of purchase)
- Rating: 755 HP (570 kw)
- Fuel Capacity: 650 U.S. Gallons (2,460 L)
- Hydraulic Capacity: 220 U.S. Gallons (833 L)
- Hydraulic Filter: High Pressure Filtration to 6 Micron ABS.

Carriage System

- Maximum Thrust/Pullback: 1,100,000 lbs. (500Tonnes)
- Carriage System: Ract & Pinion, (6) Pinion and Gear with adjustable Force Limiter
- Maximum Carriage Speed: 105 ft. (32 m)/minutes
- Carriage Motors: (6) 1017 cc Variable Displacement
- Carriage Gearbox: (6) Planetary Drives
- Hydraulic Pump: (2) Closed Loop-Piston

Rotary Drive

- Rotary System: (4) Pinion and Gear Drive with Infinitely Variable Torque.
- Maximum Rotary Torque: 100,000 ft-lbs (135,000 Nm) @ 0-75 RPM
- Maximum Rotary Speed: 75 RPM
- Rotary Motors: (4) 160cc, Axial Piston, Variable Displacement
- Rotary Brakes: (4) Spring Applied, Hydraulic Release
- Fluid Course: 4 in. (102 mm)
- Mud Flow Rate: Permits up to 1,000 U.S. Gallons (3,785 L) per minute
- Maximum Mud Pressure: 1,500 psi (103 bar)
- Mud Shutoff Cylinder: 2 in. Bore x 4 in. Stroke (51 – 305 mm)
- Mud Blow Down Cylinder: 11/16 in. Bore x 4 in. Stroke (27 – 102 mm)
- Hydraulic Pump: (2) Closed Loop-Piston
- Auxiliary Pump: (1) Pressure Compensated-Piston
- Slip Spindle: 8 5/8 in. (219 mm)

Drill Rig

- Drill Angle: 10° – 18°
- Drill Pipe: Range II – 34 ft. (10.4 m)

Dual Power Pack (ROOTS)

- Simultaneously run both power units Permits one power unit to run while powering through the unused power unit
- Allows one power unit to run, but keeps the unused power unit isolated
- Exercise the ability to have one power unit running, but have the unused power unit removed
- Unit maintains full power with single engine, but system runs with half rotational RPM and half carriage drive speed.

AMERICAN AUGERS DD 625, 300 TON PULL BACK CAPACITY HDD RIG



- Engine – Cummins QSX15 Tier 4 Final (or Tier 3 depending on country of purchase)
- Rating – 600 HP (447 KW) each
- Fuel Capacity – 650 U.S. Gallons (2,460 L)
- Hydraulic Filter – High Pressure filtration and Return to 6 Micron ABS
- Battery – (2) Deka 908DMF 24 V, 1450 CCA

Carriage System

- Maximum Thrust/Pullback – 660,000 lbs. (300 Tonnes)
- Carriage System – Rack & Pinion, (4) Pinion with Adjustable Force Limiter
- Maximum Carriage Speed – 107 ft. (33 m)/minute
- Carriage Motors – (4) Radial Piston/Dual Displacement
- Carriage Brakes – (2) Only on Carriage
- Carriage Gearbox – (4) Planetary Gearbox
- Hydraulic Pump – (4) Piston pump, Closed Loop

Rotary Drive

- Rotary System – (4) Pinion & Gear Drive w/Infinitely Variable Torque
- Maximum Rotary Torque – 80,000 ft-lbs. (108,460 Nm) @ 0 -34 RPM
- Minimum Rotary Torque – 30,000 ft-lbs. (40,675 Nm) @ 0 – 90 RPM
- Maximum Rotary Speed – 90 RPM
- Fluid Course – 3.5 in. (88.9 mm) for increased downhole hydraulic power
- Mud Flow Rate – Permits up to 1000 U.S. Gallons (3,785 L)/minute flow
- Maximum Mud Pressure – 1,500 psi (103 bar)
- Hydraulic Pump – (4) Piston Pump, Closed Loop
- Auxiliary Pump – (1) Piston Pump, pressure Compensated
- Fluid Course – 3 ¾ in. (95.25 mm) for increased downline hydraulic power
- Mud Flow Rate – Permits up to 1000 U.S. Gallons (3,785 L)/minute `+

AMERICAN AUGERS DD 220, 100 TON PULL BACK CAPACITY HDD RIG



- Engine: MTU 6R1300 Tier 4
- Rating: 523 HP (390 KW)
- Fuel Capacity: 178 U.S. Gallons (674 L)
- Hydraulic Capacity: 120 U.S. Gallons (454 L)
- Hydraulic Filter: High-Pressure Filtration Return to 6 Micron ABS

Carriage System

- Maximum Thrust/Pullback: 240,000 lbs. (108 Tonnes)
- Carriage System: Rack & Pinion, (4) Pinion Drive with Adjustable Force Limiter
- Maximum Carriage Speed: 150 ft. (46 m)/minute
- Carriage Motors: (4) Hydraulic 160cc, Radial Piston/Dual Displacement
- Carriage Brakes: (2) Spring Applied/Hydraulic Release
- Carriage Gearbox: (4) Planetary

Rotary Drive

- Rotary System: (2) Pinion & Gear Drive with Infinitely
- Maximum Rotary Torque: 43,900 ft-lbs. (59,520 Nm) @ 37 RPM
- Maximum Rotary Speed: 150 RPM
- Rotary Motors: (2) Hydraulic, 486cc, Axial Piston, Variable Displacement
- Rotary Brakes: (1) Spring Applied/Hydraulic Release
- Fluid Course: 3 in. (76 mm)
- Mud Swivel: Rear Mounted, 4 N.P.T.L.H x 3
- Slip Spindle: 5.5 in. (13.97 mm) API-IF Pin
- Other Features: Digital Tachometer, Adjustable Torque Limiter, Wiggle Steer®

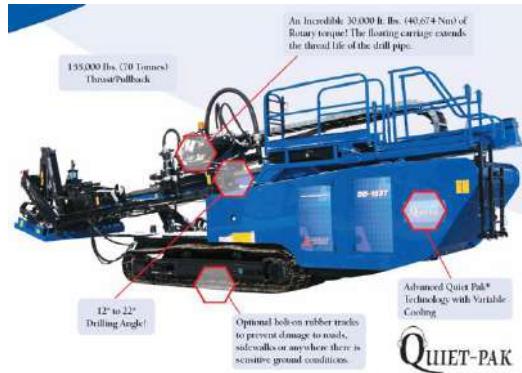
Wrench

- Triple Jaw with 10 in. (245 mm) Separation
- Maximum Breakout Torque: 80,000 ft-lbs. (108,465 Nm)
- Clamp/Grip Range: 4-1/2 in. to 8-1/2 in. (114 – 216 mm) OD

Drill Rig

- Drill Angle: 10° - 18°, wireless tramping and setup
- Drill Pipe: 20 ft. or Range II 4-1/2 in. and 5-1/2 in. API pipe
- Travel System: Self Propelled on undercarriage Steel Track Crawler Assembly
- Maximum Travel Speed: 1.4 mph (2.25 kph)

American Augers DD 155, 70 Ton Pull Back Capacity HDD Rig



- Engine: Cummins QS5B6.7 Tier 4 final (or Tier 3 depending on country of purchase)
- Rating: 260 HP @ 2200 RPM (164 KW)
- Fuel Capacity: 81 U.S. Gallons (306 L)
- Hydraulic Capacity: 107 U.S. Gallons (405 L)
- Battery: (2) Deka 908DMF 12 V, 1450 CCA – 24 V System

Carriage System

- Carriage System: (4) Pinion drive with adjustable force limiter
- Maximum Thrust/Pullback: 110,000 lbs. (50 Tonnes)
- Maximum Carriage Speed: 170 ft. (52 m)/minute
- Carriage Motors: (4) Radial piston / dual displacement
- Carriage Brakes: (2) Spring applied / hydraulic release
- Gearbox: (4) Planetary gearboxes

Rotary Drive

- Rotary System: (1) Pinion and Gear Drive with Infinitely Variable Torque
- Maximum Rotary Torque: 15,000 ft-lbs. (20,337 Nm)
- Maximum Rotary Speed: 150 RPM
- Rotary Motor: (1) Radial piston Variable Displacement
- Rotary Brakes: (1) Spring Applied/Hydraulic Release
- Rotary Gearbox: (1) Planetary Drive
- Fluid Course: 2 in. (50 mm)
- Maximum Flow: 250 U.S. Gallons (945 L)/minute flow
- Maximum Pressure: 1,500 psi (103 bar)
- Side-Entry Sub: 2 7/8 in. (73 mm) IF
- Slip Spindle: 2 7/8 in. (73 mm) IF
- Misc: Wireline Commutator, Slip Ring, Wiggle Steer®, adjustable torque limiter, digital tachometer

Drill Rig

- Drill Pipe Length: 20 ft. (6.10 m)
- Drill Angle: 10-18°
- Cabin: on-board, articulated
- Max. Pipe Basket Capacity: (9) Pieces of drill pipe
- Max. On-Board Basket: WORKING: 2
- Max. On-Board Baskets: TRANSORT: 1 (3) Pieces drill pipe in on-board staging area

Dimension

- Length: 35 ft. 7 in. (10.84 m)
- Width: 8 ft. 2 in. (2.49 m)
- Height: 9 ft. 5 in. (2.87 m)
- Track Width: 2 in. (2.5 m)

American Auger Boring Machine (72-1200)

Features

The 72-1200 Auger Boring machine has an increased ability to pull auger, steering rods, and push product. Better visibility to the master pusher with a low centerline and wide stance provides improved stability. Hydraulically-assisted clutch is easier and more comfortable to operate. The machine locks safely to the track without hook rollers. Ergonomic operating button allows for feathering rotation and slow turn of the shaft for easy auger installation. Safer operation with emergency shutdown switch at the operators station as well as an operator presence tethered switch. Updated gauge system includes the improved engine tachometer, engine warning light, & hydraulic thrust pressure reading and vivid graphics guide safe and proper machine operation.

Specification

Power Train

Engine Tier 3: Volvo TAD851VE Tier 3 Diesel

Engine Tier 4: Volvo TAD871VE Tier 4f Diesel

Rating Tier 3: 248 HP (185 kw)

Rating Tier 4: 248 HP (185 kw)

Maximum Engine Speed Tier 3: 2200 RPM

Maximum Engine Speed Tier 4: 2200 RPM

Engine Torque Tier 3: 592 ft-lbs. (803 Nm) @ 2200 RPM

Engine Torque Tier 4: 592 ft-lbs. (803 Nm) @ 2200 RPM

Engine Torque 2 Tier 3: 625 ft-lbs. (847 Nm) @ 1500 RPM

Engine Torque 2 Tier 4: 625 ft-lbs. (847 Nm) @ 1500 RPM

Fuel Capacity Tier 3: 52 U.S. Gallons (197 L)

Fuel Capacity Tier 4: 52 U.S. Gallons (197 L)

Hydraulic Capacity: 48 U.S. Gallons (181 L)

Hydraulic Capacity Tier 4: 48 U.S. Gallons (181 L)

Transmission

Type Clutch - Eaton FS-6406A – Spring applied with 15.6 in. (395 mm) diameter single disk pneumatically assisted clutch actuator.

Hydraulic System

Maximum Thrust – 1,200,000 lbs. (544 Tonnes)

Hydraulic Thrust Cylinder – (4) 9 in. Bore x 35 in. Stroke (229 mm x 889mm)

Master Pusher

Diameter – 72 in. (1,829 mm)

Working Range – 24 in. – 72 in. (610 – 1,829 mm) Casing Diameter

Hex Drive – 5 in. (127 mm)

Quik split

The quik split frame design allows the machine to be separated into sections to accommodate lighter and faster lifts into and out of the bore pit and aids the operator in being able to facilitate better and safer machine positioning.

Quik Tran

Quik Tran is the fast return system, made available exclusively from American Augers, as it provides up to 10,000 lbs. (4,536 kg) of push/pull at high speed, and there will be no dogging or winching during retract, as the Quik Tran system engages directly to the machine track. Quik Trans benefit will be easier machine operation in challenging work climates or conditions.

Spoil Door

With a safety-First commitment, all American Augers horizontal earth boring machines are equipped with a gravity activated-manual spoil door, which deflects thrown debris from the spoil chamber

Dimension

Length: 14 ft. 7 in. (4.45 m)

Width: 8 ft. 1 in. (2.46 m)

Height: 8 ft 4 in. (2.54 m)

Master Track Length: 15 ft. (45m) w/ 1.5 in. (38 mm) back plate

Master Track Width: 8 ft. (2.43 m)

Centerline: 43.47 in. (1,105 mm)

Extension Track Length: 10 ft. (3 m)

Extension Track width: 8 ft. (2.43 m)

Weights

Base Unit (Split Weight): 10,300 lbs. (4,672 kg)

Power Pack (Split Weight) Tier 3: 11,000 lbs. (4,990 kg)

Power Pack (Slit Weight) Tier 4: 11,200 lbs. (5,080 kg)

Master Pusher: 2,500 lbs. (998 kg)

Master Track: 8,200 lbs. (3,719 kg)

Lifting Sling: 900 lbs. (408 kg)

Total Weight Tier 3: 32,900 lbs. (14,923 kg)

Total Weight Tier 4: 33,100 lbs. (15,014 kg)

Miscellaneous

Work Lights: (3) 24 Volt

Extension: (2)

Master Saddle: (1) 72 in. (1,829 mm) compatible

Auger Boring Machine (48/54-900)

Features

Increased ability to pull auger, steering rods and push product.

Increased visibility to the master pusher.

Low centerline and wide stance provide increased stability

A hydraulically assisted clutch is easier and more comfortable to operate

No hook rollers, the machine looks safely to the track.

The ergonomic operating button allows for feathering the rotation and slow turn of the shaft for easy auger installation.

Emergency shutdown switch at the operator's station as well as an operator presence tethered switch.

Vivid graphics guide safe and proper machine operation

Updated gauge system includes the improved engine tachometer, engine warning light, & hydraulic thrust pressure reading.

Specification

Engine Tier: 3Deutz TCD914LO6 Tier 3 Diesel

Engine Tier 4: FinalVolvo TAD571VE Tier 4F Diesel

Rating Tier 3: 174 HP (130 kW)

Rating Tier 4 Final: 173 HP (129 kW)

Maximum Engine Speed Tier: 32300 RPM

Maximum Engine Speed Tier 4 Final: 2200 RPM

Engine Torque Tier: 3373 ft-lbs. (505.7 Nm) @ 2300 RPM

Engine Torque Tier 4 Final: 395 ft-lbs. (536 Nm) @ 2200 RPM

Engine Torque 2 Tier: 3468 ft-lbs. (634.5 Nm) @ 1600 RPM

Engine Torque 2 Tier 4 Final: 597 ft-lbs. (809 Nm) @ 1200 RPM

Fuel Capacity Tier: 339 U.S. Gallons (148 L)

Fuel Capacity Tier 4 Final: 33 U.S. Gallons (125 L)

Hydraulic Capacity Tier: 322 U.S. Gallons (83 L)

Hydraulic Capacity Tier 4 Final: 22 U.S. Gallons (83 L)

Transmission

Type: Eaton FS-5205A, 5-speed

Type Tier 3: Eaton FS-5205A, 5-speed

Type Tier 4 Final: Spring applied with 14 in. (356 mm) diameter single disk hydraulically-assisted clutch actuator

Clutch: Spring applied with 14 in. (356 mm) diameter single disk hydraulically-assisted clutch actuator

Gearbox

Ration: 38.8:1

Hydraulic System

Maximum Thrust: 900,000 lbs. (408 Tonnes)

Hydraulic Thrust Cylinder: (3) 9 in. Bore x 35 in. Stroke (229 mm x 889 mm)

Master Pusher

Diameter: 48 in. (1,219 mm)

Working Range: 24 in. – 54 in. (610 – 1,372 mm) Casing Diameter

Hex Drive: 5 in. (127 mm)

Quik Split

The Quik Split frame design allows the machine to be separated into sections to accommodate lighter and faster lifts into and out of the bore pit and aids the operator in being able to facilitate better and safer machine positioning.

Quik Tran

Quik Tran is the fast return system, made available exclusively from American Augers, as it provides up to 10,000 lbs. (4,536 kg) of push/pull at high speed, and there will be no dogging or winching during retract, as the Quik Tran system engages directly to the machine track. Quik Trans benefit will be easier machine operation in challenging work climates or conditions.

Spoil Door

With a Safety-First commitment, all American Augers horizontal earth boring machines are equipped with a gravity activated-manual spoil door, which deflects thrown debris from the spoil chamber.

Dimension

Length14 ft. 6 in. (4.42 m)

Width5 ft. 10 in. (1.78 m)

Height Tier 36 ft. 2 in. (1.89 m)

Height Tier 46 ft. 7 in. (2.03 m)

Master Track Length15 ft. (4.57 m) w/1 in. (25 mm) back plate

Master Track Width5 ft. 6 in. (1.67 m)

Centerline32.89 in. (835.4 mm)

Extension Track Length10 ft. (3 m)

Extension Track Width5 ft. 3 in. (1.60 m)

Weights

Base Unit (Split Weight)6,150 lbs. (2,790 kg)

Power Pack (Split Weight) Tier 37,200 lbs. (3,266 kg)

Power Pack (Split Weight) Tier 49,300 lbs. (4,218 kg)

Master Pusher1,600 lbs. (726 kg)

Master Track3,900 lbs. (1,769 kg)

Lifting Sling350 lbs. (159 kg)

Total Weight Tier 319,200 lbs. (8,709 kg)

Total Weight Tier 421,300 lbs. (9,662 kg)

Extension Track3,500 lbs. (1,588 kg) each

Master Saddle250 lbs. (114 kg)

Miscellaneous

Work Lights: (3) 12 Volt

Extension Track: (2)

Master Saddle: (1) 48 in. (1,219 mm) compatible

Micro Tunneling & Pipe Pusher Equipment

AugerPro System - Pipe Jacking

Tunnel length:	Up	to	300m
Diameter:	OD200	-	OD1600
Geology:	soft ground (sand, silts, clay), without any boulders		

Features:

- Low groundwater level
- Excavated soil is transported by auger train to the start shaft
- Push pipes directly after drilling

Slurry Systems - Pipe Jacking

Tunnel length:	1.000m	and	more
Diameter:	OD350	-	OD4000
Geology:	All conditions		

Features:

- Difficult soil with high levels of ground water
- For very long distances and large diameters
- Excavated spoil is mixed with water, transportation to the surface
- Water and spoil get separated, water maintains in the slurry circle
- Four different modes, usability for different geologies
- Additives or betonite are not required

mts Hybrid:

Slurry systems - suitable for pipe jacking and segmental lining projects
If there is no possibility for building a rescue shaft > switch to segmental mode > finish tunnelling

EPB Systems - Pipe Jacking

Tunnel length:	1.000m	and	more
Diameter:	OD1200	-	OD4000
Geology:	Soft ground		

Features:

- Fine soils with low water permeability
- For very long distances
- Excavated soil gathers in the excavation chamber
- Soil and advancing force build the support pressure
- Excavated soil transported by screw conveyor out of the excavation chamber
- By conveyor belts or lorries to the launching shaft

mts Hybrid: EPB systems - suitable for pipe jacking and segmental lining projects
If there is no possibility for building a rescue shaft > switch to segmental mode >
finish tunnelling

Hard Rock Systems - Pipe Jacking

Tunnel length:	1.000	m	and	more
Diameter:	DN 1200	-	DN	4000
Geology:	fractured and unfractured Rock			

- Features:
- With a gripper station in stable ground conditions
 - Grip against the tunnel wall to move forward
 - In fractured rock > unstable tunnel walls supported by pipes or segments
> [Segmental Lining](#)

Relevant Plant, Equipment & Facilities

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1.0 HDD & THRUST BORING EQUIPMENT & MACHINERY OWNED BY HDD THAILAND - ENIKKOM LIMITED AND AVAILABLE FOR THE WORK

ENIKKOM, owns 9Nos. HDD Rigs, 4Nos. Thrust Boring Machine, 1No. Pusher and Other Underground / Down Hole Tools and Accessories. These equipment and machinery are located in-country in Nigeria and will be readily available for this work.

These equipment and machinery are as listed below:

S/N	DESCRIPTION	MAKE	CAPACITY	YR OF PURC.	QTY
• HDD DRILLING RIGS					
1	DD 580 HDD RIG	American Augers	300 Tons Pullback	2000	1-Nos
2	ASTEC 3238 HDD RIG	American Augers	15 Tons Pullback	2008	1-Nos
3	DD 440T HDD RIG	American Augers	200 Tons Pullback	2008	1-Nos
4	DD 1100 HDD RIG	American Augers	500 Tons Pullback	2012	1-Nos
5	DD 1100 HDD RIG	American Augers	500 Tons Pullback	2012	1-Nos
6	DD 625 HDD RIG	American Augers	300 Tons Pullback	2012	1-Nos
7	DD 220T HDD RIG	American Augers	100 Tons Pullback	2012	1-Nos
8	DD1100 HDD RIG	American Augers	500 Tons Pullback	2013	1-Nos
9	DD 150 HDD RIG	American Augers	70 Tons Pullback	2013	1-Nos
• THRUST BORING MACHINES & ACCESSORIES					
1	72-1200 NG Thrust Boring Machine	American Augers	1.2m Pound	2013	1-Nos
2	48/54-G900 Thrust Boring Machine	American Augers	900,000 Pound	2010	1-Nos
3	36 – 340 Thrust Boring Machine	American Augers	340,000 Pound	2008	1-Nos
4	24 - 100 Thrust Boring Machine	American Augers	100,000 Pound	2004	1-Nos
• MICRO TUNNELING & PIPE PUSHER EQUIPMENT					
1	800t Micro tunneling Equipment	MTS	800t	2021	1-Nos
2	380 Ton Pipe Pusher – Prime Drilling	Prime Drilling	36” – 60”x380Tons	2015	1-Nos
• DRILL PIPES					
1	5" DRILL PIPES	JAPAN		2010	Various
2	6-5/8" DRILL PIPES-25lb/ft	AMERICAN	S-135	2013	Various
3	6-5/8" DRILL PIPES - 27lb/ft	JAPAN	S-135	2013	Various
4	6-5/8" DRILL PIPES-35lb/ft	China	S-135	2021	Various
• SPECIALIZED EQUIPMENT					
1	THUMPER	TT TECHNOLOGIES	24"	2013	Owned
2	THRUSTER 24"-48"	PRIME	24-48"	2013	Owned
3	MOBILE BREAKOUT UNIT	HERENKENETT	4-1/2 TO 6-5/8	1013	Owned
• MUD MIXING, CLEANING & RECYCLING SYSTEMS					
1	Mud Mixing Unit	Juesco	MMU	2016	Various
2	Mud Cleaning & Recycling System (MCR-10000)	A/Augers	MCR10000	2014	2 Nos
3	Mud Processing and Recycling (MPR 6000)	A/Augers	MPR6000	2014	2 Nos
4	Mud Cleaning & Mixing Unit (MCM 4000)	A/Auger	MCM 4000	2013	2 Nos
5	Mud Cleaning Technology (MCT 2000)	A/Auger	MCT2000	2013	1 Nos
6	Mud Cleaning System (MCS 750)	A/Auger	MCS750		1Nos
• MUD PUMPS					
1	Mud Pump (P-600)	A/Auger	Tri-plex 600GPM	2013	2Nos
2	Mud Pump (P-750)	A/Auger	Quintiplex, 750GPM	2013	1Nos

Commented [ES1]: Insert quatities and wall thickness for the drill pipes

Commented [ES2]: Specialized equipment.. take up

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S/N	DESCRIPTION	MAKE	CAPACITY	YR OF PURC.	QTTY
3	Mud Pump	A/Auger (Kerr Pump)			
4	Hydraulic Mud Pump	Herrenknecht		2015	
5	Mud Pump	John Deere		2013	
2	FRAC TANKS	MUD TECHNOLOGIES	500 BARREL	2012	4 Nos
• REAMERS AND SUBS					
1	BR 6 5/8" FH (18", 24", 30", 36", 42", 48" & 54")	INROCK	18" - 54"	2010	Various
2	FC 6 5/8" FH (18", 24", 30", 36", 42", 48" & 54")	INROCK	18" - 54"	2013	Various
3	BR 4-1/2" IF (18", 24", 30", 36", 42", 48" & 54")	INROCK	18" - 54"	2009	Various
4	FC 4-1/2" IF (18", 24", 30", 36", 42", 48" & 54")	INROCK	18" - 54"	2010	Various
5	XO SUBS	INROCK	4-1/2" & 6-5/8"	2010-13	Various
6	SAVER SUBS	INROCK	4-1/2" & 6-5/8"	2010-13	Various
7	WEEPER SUBS	INROCK	4-1/2" & 6-5/8"	2010-13	Various
8	ORIENTATION SUBS	INROCK	4-1/2" & 6-5/8"	2010-13	Various
9	BENT SUB	INROCK	1 DEG TO 2DEG	2010-13	Various
• PIPE ROLLERS					
1	20Ton 12" to 48" Pipe Rollers	TRENCHLESS	10T	2013	Various
2	15 Ton 12" - 48" Pipe Rollers	TRENCHLESS	15T	2011	Various
3	10 Ton 12" - 48" Pipe Rollers	LJ WELDING	20T	2010	Various
• ROLLER CRADDLES					
1	24" ROLLER CRADDLES	LJ WELDING	24"	2012	Various
2	36" ROLLER CRADDLES	LJ WELDING	36"	2013	Various
3	48" ROLLER CRADDLES	LJ WELDING	48"	2010	Various
• OTHER DOWNHOLE TOOLS					
1	8" MONEL C/W DOWN HOLE ASSEMBLY	INROCK		2012	Owned
2	6" MONEL C/W DOWN HOLE ASSEMBLY	INROCK		2012	Owned

Commented [ES4]: Insert quantities and size of the reamers

2.0 OTHER CONSTRUCTION EQUIPMENT & MACHINERY OWNED BY ENIKKOM LIMITED AND AVAILABLE FOR THE WORK – DRY PLANTS & MARINE EQUIPMENT

ITEM	DESCRIPTION & MAKE	CONDITION	OWNED / LEASED	QTY
• PILING EQUIPMENT				
1	ABI 90-TON TRACK VIBRATORY PILING HAMMER	GOOD	OWNED	2
2	ICE 3117 VIBRO HAMMER & POWER PACK	GOOD	OWNED	1

ITEM	DESCRIPTION & MAKE	CONDITION	OWNED / LEASED	QTY
• EXCAVATORS				
1	CAT 320CL EXCAVATOR	GOOD	OWNED	Various
2	CAT 330CL EXCAVATOR	GOOD	OWNED	Various
3	CAT 330DL EXCAVATOR	GOOD	OWNED	Various
4	CAT 325CL EXCAVATOR	GOOD	OWNED	Various
• SWAMP BUGGY				
1	WILCO SWAMP BUGGY	GOOD	OWNED	6
• BULLDOZER & PAIL LOADER				
1	DOZER D7R, D6H	GOOD	OWNED	3
2	PAIL LOADER 966 CAT	GOOD	OWNED	3
3	WHEEL LOADER 950 CAT	GOOD	OWNED	2
4	CAT 750 GRADER / RIPPER	GOOD	OWNED	2
• SIDE BOOMS				
10	SIDE BOOMS – 40T	GOOD	OWNED	6
11	SIDE BOOMS – 35T	GOOD	OWNED	4
• COMPRESSOR				
15	COMPRESSORS – INGERSOLL RAND	GOOD	OWNED	10
• GENERATOR				
16	GENERATORS (20KVA – 500KVA)	GOOD	OWNED	Various
• WELDING MACHINE & ACCESSORIES				
1	BENDING MACHINE – 16" TO 24" CRC EVANS	GOOD	OWNED	1
2	WELDING MACHINE – LINCOLN 450V (MANUAL AND ARC)	GOOD	OWNED	24
3	GRINDING MACHINE	GOOD	OWNED	6
• CRANES				
1	CRANE (TELESCOPIC TYPE) – 10 TONS	GOOD	OWNED	2
2	CRANE (TELESCOPIC TYPE) – 25 TONS	GOOD	OWNED	2
3	CRANE (TELESCOPIC TYPE) – 30 TONS	GOOD	OWNED	3
• TRUCKS				
1	FLAT BED TRAILERS (DOUBLE AXLE) – MACK	GOOD	OWNED	16
2	FLAT BED TRAILERS (4 X 4) – MECERDES BENZ	GOOD	OWNED	14
3	LOW BED TRAILER (4 X 4) – MECERDES BENZ – 45 TONS	GOOD	OWNED	2
4	LOW BED TRAILER (4 X 4) – 70-80 TONS	GOOD	OWNED	2
5	SALVAGE TRUCKS (MACK) – DOUBLE AXLE	GOOD	OWNED	1
6	OIL & LUBE TRUCK	GOOD	OWNED	2
7	DIESEL TRUCK	GOOD	OWNED	2
8	WATER TANKER – 3000 LITERS	GOOD	OWNED	2
9	SELF LOADER – 10 TON LIFTING CAPACITY (DOUBLE AXLE)	GOOD	OWNED	1
10	SELF LOADER – 7 TON LIFTING CAPACITY (DOUBLE AXLE)	GOOD	OWNED	1
11	DAF 1800, 4 X 4 WHEEL DRIVE BUS	GOOD	OWNED	4
12	UNIMOG 1300, 4 X 4 WHEEL DRIVE BUS	GOOD	OWNED	4
• LIGHT VEHICLES				
1	TOYOTA HIACE BUS – 18 SEATER	GOOD	OWNED	12
2	TOYOTA HILUX PICK-UP – 4 X 4 WHEEL DRIVE	GOOD	OWNED	8
3	TOYOTA LAND CRUISER, HARD BACK 4 X 4 WHEEL DRIVE FIELD TRUCK (COVERED)	GOOD	OWNED	4

ITEM	DESCRIPTION & MAKE	CONDITION	OWNED / LEASED	QTY
4	TOYOTA PRADO 4 X 4 WHEEL DRIVE	GOOD	OWNED	5
5	MEDIVAC VAN – MERCEDES G40	GOOD	OWNED	2
• DREDGING & MARINE EQUIPMENT				
1	MV Donaux	GOOD	OWNED	1
2	ENIKKOM ELICOTT DRAGON DREDGER, SERIES 1170-50 (CUTTER SUCTION) 16"/16" – MV KENENNA	GOOD	OWNED	1
3	ENIKKOM ELICOTT DREDGER, SERIES 670-42 (CUTTER SUCTION) 14"/14" – MV KECHIKEMDI	GOOD	OWNED	1
4	SWAMP BUGGY EXCAVATOR WITH CAT 320 BACK HOE	GOOD	OWNED	6

3.0 DETAILED SPECIFICATIONS OF HDD RIGS AND EQUIPMENT OWNED BY HDD THAILAND – ENIKKOM LIMITED

Enikkom Construction Limited HDD Rig No. 1

American Augers DD 580, 300 Ton Pull Back Capacity HDD Rig



- 580,000 lb (300 tonnes) of thrust/pullback power
- 58,000 ft-lb (88,000 Nm) of rotary torque easily turns large reamers in long bores 900 hp (582 kW) Caterpillar® diesel power
- 3.75 inch (95mm) fluid course permits flow up to 850 gpm (3,200 liters/min)
- Floating Spindle™ allows simple, reliable makeup and breakout
- Pipe Hog™ triple jaw wrenches travel for precise alignment to pipe joints
- Quik Change Die Holders™
- Wiggle Steer™
- Factory direct service for fast support by knowledgeable technicians
- ES!LOK® exit-side lock out
- Rack & pinion four (4) pinion drive with adjustable force limiter
- Wireline commutator for speedy hookup of wireline guidance equipment with terminals at driller's console
- Independent controls and hydraulic circuits for thrust/pullback, torque and auxiliary operations permits simultaneous full power operation
- Driller's cabin with heat and air conditioning

Enikkom Construction Limited HDD Rig No. 2

ASTEC 3238, 15 ton Pull Back Capacity HDD Rig



ENGINE

John Deere® 4045T Diesel I Rating 125 hp (93.2 kW)
Other features: Quiet-Pak® Sound reduction system is standard.

Rotary DRIVE

Rotary system Pinion and gear drive, infinitely variable speed & torque Rotary (high torque 3,800 ft-lb (5,152 Nm)
Maximum rotary speed 225 rpm
Fluid course.0.812 in. diameter

Carriage DRIVE

Maximum thrust/pullback.32,000 lbs (14.5 Tonnes)

Drill angle

15.5°/27% grade

DRILLING FLUID PUMP

Tiple pump Output 0-47 gpm (178 L/min)
Maximum pressure 1,500 psi

- Carriage speed Up to 120 ft/min (36.6 m/min)
- PIPE Loader State-of-the-art rod loader uses 10 ft (3.05m) drill stem. Total pipe capacity is 500 ft (152.4 m).
- Rod Length 10 ft (3,048 mm)
- Outside diameter (tube)2.375 in (60.5 mm)
- Tool joint O.D2.625 in (66.5 mm)
 - Fluid Course 1.875 in (48 mm)

Enikkom Construction Limited HDD Rig No. 3

AMERICAN AUGERS DD 440T, 200 TON PULL BACK CAPACITY HDD RIG WITH MPR-6000 DRILLING FLUID MIXING,
PUMPING & RECYCLING SYSTEMS



American Augers DD 440T Features And Benefits

- Cummins Tier III, 600 HP (441.3 kW) Diesel Engine
- 440,000 lbs. (200 Tonnes) of Maximum Thrust/Pullback Power
- 60,000 ft-lbs. (81,350 Nm) of Maximum Torque
- Rack and Pinion (2) Pinion Drive with Adjustable Force Limiter
- Track Mounted Undercarriage Travel Assembly
- Triple Jaw Wrench with 12 in. (305 mm) Separation
- 4 in. (102 mm) Fluid Course permits 1,000 U.S. Gallons (3,785 L)/per minute flow
- Accommodates Range II Drill Pipe
- 10°- 18° Variable Drilling Angle
- Wiggle Steer®
- Quiet-Pak® Noise Reduction System
- MPR-6000 - Features And Benefits
- (2) Tank System - 2,000 U.S. Gallons (7,750 L) Screen Tank, and 4,000 U.S. Gallons (15,140 L) Clean Fluid/Mixing Tank
- **NEW! On board Tri-plex Mud Pump with 600 U.S. Gallons (2,271 L)/minute pumping capacity**
- Caterpillar C-15 475 HP (336 kW) Diesel Engine
- Caterpillar 60 Hz (114 kW) Generator Set
- (2) Linear Motion Shakers
- 300 U.S. Gallons (1,135.5 L)/minute 1st Cut Shaker Cleaning Capacity
- 720 U.S. Gallons (2,725 L)/minute Desilting System Cleaning Capacity
- Polyethylene Constructed Dry Bentonite Mix Hopper
 - Tri-Axle Mounting with Rockover Design

Enikkom Construction Limited
Technical Specification for HDD Rig No. 4, Rig No. 5 and Rig No. 8

AMERICAN AUGERS DD 1100, 500 TON PULL BACK CAPACITY HDD RIG WITH MCR-10000 DRILLING FLUID CLEANING SYSTEMS



American Augers DD 1100, 500 Ton (Features and Benefits)

- Caterpillar® 765 HP (570 kw) C-18 Tier III Diesel Engine
- 1,100,000 lbs. (500 Tonnes) of Maximum Thrust/Pullback Power
- 100,000 ft-lbs. (136,000 Nm) of Maximum Rotary Torque
- Rack & Pinion 4 Pinion Drive with Adjustable Force Limiter
- Wrench Travels Full Length of Thrust Frame
- Hydraulically Operated Pipe Supports
- 4 in. (102 mm) Fluid Course permits 1,000 U.S. Gallons (3,785 L)/per minute flow
- Accommodates Range II Drill Pipe
- 10° - 18° Variable Drilling Angle
- Floating Spindle™ Allows Simple Makeup and Breakout
- Dedicated Pumps for Rotary and Thrust
- Adjustable Torque Limiter for Rotary and Makeup Force
- Run-On-One-Technology-System (ROOTS) capable
- Trailer Mounted on Air Ride Suspension , High Legal Load
- Wireline commutator for speedy Hookup wireline Guidance Equipment with Terminals at Drill Console.
- ESIL ok Lockout System
- Drillers' Cabin With Heat and Air Conditioning

MCR-10000 Drilling Fluid Cleaning Systems (Features and Benefits)

- On Board 60 Hz Electrical Generator Set
- Cummins diesel 8.9 L
- Centrifugal Mud Pump
- Linear Motion Shakers
- 1st Cut Cleaning Capacity is 900 U.S. Gallons (3,406 L) [estimate]
- (4) 10 in. (254 mm) Krebs gMax® desanding/desilting hydro-cones manifold mounted
- Particle Separation Cleaning Capacity is 1,500 U.S. Gallons (5,678 L) [estimate]
- Large Fluid Processing Tanks
- Rock-over design on Tri-Axle suspension

Enikkom Construction Limited HDD Rig No. 6
American Augers DD 625, 300 Ton Pull Back Capacity HDD Rig



Features And Benefits

- Cummins Tier III, 600 HP (441.3 kW) Diesel Engine
- 625,000 lbs. (283 Tonnes) of Thrust/Pullback Power
- 80,000 ft-lbs. (108,500 Nm) of Maximum Rotary Torque
- Rack & Pinion 4 Pinion Drive with Adjustable Force Limiter
- Wrench Travels Full Length of Thrust Frame
- 3 in. (76 mm) Fluid Course permits 650 U.S. Gallons (2,460 L)/per minute flow
- Accommodate Range II Drill Pipe
- 4 in. (102 mm) Fluid Course permits 1,000 U.S. Gallons (3,785 L)/per minute flow
- 10° - 18° Variable Drilling Angle
- Floating Spindle™ Allows Simple Makeup and Breakout
- Dedicated Pumps for Rotary and Thrust
- Run-On-One-Technology-System (ROOTS) capable



(and Benefits)

- Centrifugal Mud Pump
- Linear Motion Shakers
- 1st Cut Cleaning Capacity is 900 U.S. Gallons (3,406 L) [estimate]
- (4) 10 in. (254 mm) Krebs gMax® desanding/desilting hydro-cones manifold mounted
- Particle Separation Cleaning Capacity is 1,500 U.S. Gallons (5,678 L) [estimate]
- Large Fluid Processing Tanks
- Rock-over design on Tri-Axle suspension

Enikkom Construction Limited HDD Rig No. 7

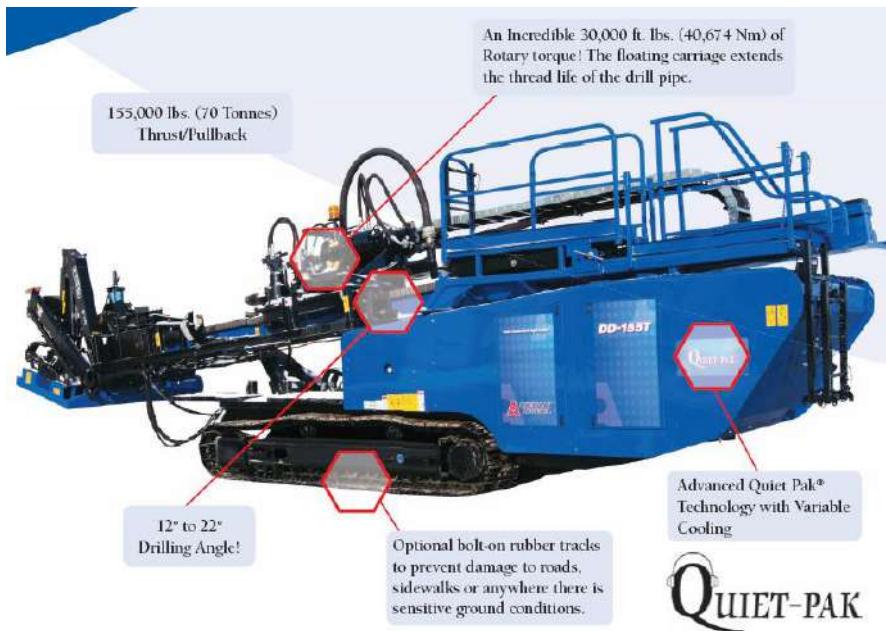
American Augers DD 220, 100 Ton Pull Back Capacity HDD Rig



- Cummins QSL9P Tier 3 / Tier 4 interchangeable engine
- 220,000 lbs. (100 Tonnes) of Maximum Thrust/Pullback Power
- 30,000 ft-lbs. (40,674 Nm) of Maximum Rotary Torque
- Rack & Pinion (6) Pinion Drive with Adjustable Force Limiter
- Open Top Wrench Type with 10 in. (245 mm) Separation
- Accommodates Range II Drill Pipe
- 10° - 18° Variable Drilling Angle
- Optional Kuckle-Boom Crane
- 3 in. (76 mm) Fluid Course permits 650 U.S. Gallons (2,460 L)/per minute flow
- Wiggle Steer®
- Trailer Low Boy (45 FT) Non Permit
- Triple Cylinder Wrench Clamp
- MPR-6000 - Features And Benefits*
- (2) Tank System - 2,000 U.S. Gallons (7,750 L) Screen Tank, and 4,000 U.S. Gallons (15,140 L) Clean Fluid/Mixing Tank
- **NEW! On board Tri-plex Mud Pump with 600 U.S. Gallons (2,271 L)/minute pumping capacity**
- Caterpillar C-15 475 HP (336 kW) Diesel Engine
- Caterpillar 60 Hz (114 kW) Generator Set
- (2) Linear Motion Shakers
- 300 U.S. Gallons (1,135.5 L)/minute 1st Cut Shaker Cleaning Capacity
- 720 U.S. Gallons (2,725 L)/minute Desilting System Cleaning Capacity
- Polyethylene Constructed Dry Bentonite Mix Hopper
- Tri-Axle Mounting with Rockover Design

Enikkom Construction Limited HDD Rig No. 9

American Augers DD 155, 70 Ton Pull Back Capacity HDD Rig



American Augers DD 155T Features And Benefits

- Newest Mid-Sized HDD Rig
- Low Noise Design
- Incredible Torque
- Unique Drilling Angles Available with Multi-Functional Job-Easing Options
- 155,000 lbs (70 tonnes)
- 30,000 ft. lbs. torque (40,674 Nm)
- 120 to 220 Drilling Angle
- Optional Knuckleboom Crane
- Rod Loader
- 20ft. (6.1m) Drill Pipe

4.0 FACILITIES AND OFFICES

HDD THAILAND – ENIKKOM LIMITED owned facilities and offices are Project Management and Fabrication Facilities which are utilized for our projects.

These details of these facilities are as listed below,

**HDD THAILAND - ENIKKOM LIMITED
KM 18, EFFURUN – OTOKUTU EXPRESS WAY,
WARRI,
DELTA STATE, NIGERIA.**

The detailed description and pictures of the PMT and Fabrication Facility is as follows:

Site	<ul style="list-style-type: none">• 3 acres of land along DSC express road• Entry drive, gate/gate house, fencing, truck court for trucks, car park, land development for the purposes of the building.
Buildings	<ul style="list-style-type: none">• Ware House• Administrative Block
	<ul style="list-style-type: none">• Community Engagement
	<ul style="list-style-type: none">• And Others

4.1 Office Section

- Office room height: at least 3m clear height.
- 100 mm thick gypsum board partitions on steel system profiles, with mineral wool soundproofing, double coated with white emulsion paint.
- Floor finish: carpeting in office areas, ceramic tiles or PVC floor lining in personnel areas.
- Ceiling finish: mineral system ceiling suspended on a frame, 60 cm x 60 cm white panels.
- Aluminum window joinery, powder coated to RAL5003.
- Frame-and-panel internal doors (Porta, DRE or equivalent), steel frame powder coated to standard color.

4.2 Other Services

- Technical support and backup for the operating and running projects
- Community engagement and social responsibility on-behalf of Zakhem Nigeria Ltd.





INTRODUCTION

Pipeline Infrastructure ENIKKOM JV Ltd is a joint venture between OCEAN MARINE SOLUTIONS LTD (OMS) and ENIKKOM CONSTRUCTION LIMITED (ECL). The Company was set up for the sole purpose of Infrastructure Development, Maintenance and Management in the Oil and Gas Industry.

OCEAN MARINE SOLUTIONS LIMITED (OMS) was formed in 2007 to provide innovative solutions to the rising spate of offshore and maritime security threats that attempts to cripple the petroleum upstream operations with the attendant huge economic loss to corporate organizations and the government. OMS, as the pioneer Private Maritime Security Company (PMSC) introduced the novel approach of strategic partnership with the Nigerian Navy to provide a resilient and efficient methodology to effectively counter offshore threats and provide vital static asset protection to the oil and gas industry and much needed escort services for commercial vessels transiting through Nigerian waters.

OMS operate an impressive fleet of over 40 purpose-built Patrol Boats, fitted with comprehensive communications equipment enabling full situational awareness for our clients' enhanced protection which are coordinated from our Security Operations Centres (SOC) in Lagos, Warri & Port Harcourt and sprawling ship maintenance workshops at the aforementioned locations. The OMS SOC centres are managed by well-trained security specialists, both local and expatriate, who have extensive experience in the global maritime security sector. These SOC Centres, manned 24/7/365 by our well-trained watch keepers, are all equipped with dedicated automatic Identification System (AIS) technology, which along with substantial VHF, HF and satellite systems, ensure uninterrupted communications and continuous situational awareness of all our maritime operations. OMS create the enabling platform to the Nigerian Navy to maintain a greater presence at sea and enhancing her surveillance and information gathering capabilities.

With a sustained and increasing global focus on the challenges of piracy in the Gulf of Guinea, we pride ourselves on delivering the best possible security solutions to the oil and gas and shipping industries with a proud success record of maintaining a 100% success in deterring threats from piracy and terrorism, operating in one of the most complex environments in the world.

OMS has extended her track record of excellence in security management to the security and maintenance of the Nation's pipeline infrastructure in the volatile Niger Delta region for constant delivery of crude oil feedstock to the refineries for local consumption. Current pipeline security and maintenance operations include the following segments:

- **24" x 60km Escravos – Warri Crude Oil Pipeline**
- **24" x 56km Bonny – Port Harcourt Crude Oil Pipeline**
- **16" x 36km Opuama – Otumara Crude Oil Pipeline (OML 40)**
- **87km Multi-Diameter Trans-Forcados Crude Oil & IN-Field Pipelines**

ENIKKOM CONSTRUCTION LIMITED (ECL) was incorporated on the 23rd day of March 2009 to specifically handle the Pipeline Construction (Land & Swamp, Offshore, Horizontal Directional Drilling-HDD, Horizontal Drilling-Thrust Boring), Steel and Metal Fabrication (Storage Tanks, Process Works), Dredging works, Civil Construction (Piling, Jetty, Bridges), contract portfolio of her parent company, Enikkom Investment Services Nigeria Limited (EISNL) – A highly diversified Engineering Services Company established in 1995.

ECL was established as a result of the realization of the huge opportunities which the pipeline construction business presents in Nigeria and the need to setup a dedicated company for the purpose of exploiting these opportunities.

ECL is a wholly Nigerian indigenous company that pools the expertise of very experienced engineers, technicians and personnel to provide services within the oil and gas industry. ENIKKOM's strength is in the depth and breadth of her Construction, CASHES and Project Management Technology which covers key projects on land and swamp.

ECL the leader and pioneer HDD contractor in Nigeria (Since 2003, 10, Rigs and counting) We have completed over 100km of HDD installations over the last 16 years from 4" to 40" in pipe size diameter and length ranging from 50m to 3.1km single drill. As pioneers of Horizontal Directional Drilling (HDD) in Nigeria, ECL's technical understanding / capability places us within a select crowd of HDD service providers in Africa, underpinning our vast management experience.

We recently in April of 2016 completed the longest single drill in Africa in terms of distance (3.1km x 16" Arepo /Imagbon line on the Atlas cove to Mosimi Pipeline.

Also, we hold the record in depth of crossing in Africa with the successful completion of the 36" x 1.2km Ekiadalor Deep Valley Crossing. This installation was achieved at a depth of more than 80m in February of 2016.

OUR RANGE OF SERVICES INCLUDE:

I. Project Management/ Consultancy Services

Project Planning, Management and Support, Project Control, Material Control, Inspection, Construction Management, Commissioning and Start Up

ii. Engineering & Maintenance Services

Land/Swamp Flowlines /Pipelines Construction and Maintenance, Structural Construction, Plant Turn-Around Maintenance

iii. Trenchless Crossings

Horizontal Directional Drilling Services (HDD), Guided Boring (Thrust Boring), Micro Tunnelling – Slurry Spoil Removal System, Horizontal Boring (Hole Hog), Pipe Ramming (Casing Installation), HDD Rescue, Pneumatic Pipe Bursting, Static/Hydraulic Pipe Bursting

iv. Civil Construction

Civil Construction Design, Building and Renovation of Existing Structures, Roads and Highway Construction, Shoreline Protection Structures, Bond Walls, Steel and Timber Structural Works, Jetty Construction, Drainage and Landscaping Works, Geotechnical Engineering and Flood/ Erosion Control, Civil Engineering Project Feasibility and Development studies

v. Dredging & Piling

Slot/Access Sweeping and Maintenance, Land Reclamation, Stockpiling, Capital Dredging, Removal of Obstruction from Sea Beds/Waterways & Canals, Pile Driving / Pile Extraction, Drilled Shaft/Bored Pile, Foundation Piling, Shore Protection Piling

vi. Production Operations

Flow station and well head operations, greasing of well head and process valves, pigging of pipelines, flowline and pipeline leak repair, well head upgrade, manifold inspection and maintenance, pipeline pigging operations

vii. Logistics Support Services

Land Logistic Support (Low bed trailers, Self-loaders, Pick-up trucks, Flat bed trailers, Low loaders), Swamp Logistics Support Services (Flatbed barges, Ramp barges, Crew boats, Supply Vessels).

STRATEGIC ALLIANCES

HDD THAILAND is a major player in the International Oil industry. They are one of the fore most Horizontal Directional Drilling Engineers and Contractors in the world. They provide Engineering/Drafting Services, Project Management from Project Definition/Feasibility Studies to Equipment and Materials Procurement/ Installation and commissioning.

For our Directional Drilling projects, HDD THAILAND provides ENIKKOM with Engineering services, Project Management Services. HDD THAILAND has implemented quality assurance procedures that are consistent with ISO-9001 certification.

Total Quality Management and Continuous Improvement

A key feature of the PIEJV Ltd, is the Quality Management and Continuous Improvement through integrated system of tools, techniques and trainings to focus on improvement of organizational processes resulting in high quality product and services

Thanks to synergies between our major companies and our strategic partners, **PIEJV Ltd** can offer its clients a comprehensive range of services throughout the project value chain, including needs analysis, financial and technical engineering, project development, design, turnkey projects, construction, maintenance and operation.

PIEJV Ltd places social, societal and environmental challenges at the heart of its development strategy, with the aim of being a leader in sustainable construction.

In summary, the combination of our technical operations skills with that of our partner's experience, our productivity and quality assurance philosophies ensure that **PIEJV Ltd** shall deliver subject project on schedule, effectively to meet operations requirements, and CLIENT will have the best return on investment.

OFFICE & FACILITIES –

Corporate Office – Headquarters	Operational Base Office	Fabrication Yard / Loading Jetty
Address: 2, Gado Nasko Close, Asokoo, Abuja, FCT.	Address: Km18, DSC Express Way, Otokutu Junction, Delta State.	Address: Opete Road, Opposite Ejovi Jetty, Opete, Warri
Tel/Fax: +234 (0)80–35082614, +234 (0)703-5557575	Tel/Fax: +234 (0) 805-5550047	+234 (0) 803-6703416
Email: info@enikkom.com info@ocean-ms.com	Email: info@enikkom.com info@ocean-ms.com	Email: info@enikkom.com info@ocean-ms.com
www.ocean-ms.com www.enikkom.com	www.ocean-ms.com www.enikkom.com	www.ocean-ms.com www.enikkom.com

ENIKKOM is proud to be associated with Land and Marine Project Engineering Limited both locally and internationally.

LAND AND MARINE PROJECT ENGINEERING LIMITED is a major player in the International Oil industry. They are one of the fore most Horizontal Directional Drilling Engineers and Contractors in the world. They provide Engineering/Drafting Services, Project Management from Project Definition/Feasibility Studies to Equipment and Materials Procurement/Installation and commissioning.

For our Directional Drilling projects, LAND AND MARINE provides ENIKKOM with Engineering services, Project Management Services. LAND AND MARINE has implemented quality assurance procedures that are consistent with ISO-9001 certification.

ENIKKOM is proud to be associated with American Augers INC for both locally and internationally.

AMERICAN AUGERS INC, U.S.A is the world's leading manufacturer and supplier of both auger boring machines and directional drills with over 1,100,000lb (500tons) of pullback force. They manufacture state-of-the-art auger boring machines, directional drills, and fluid/mud systems used in the "underground construction" or "trenchless" market.

For our Directional Drilling projects, **AMERICAN AUGERS** provides ENIKKOM with HDD Rigs and Thrust Boring Machines including spares for the equipment. They also provide us with the Technical Manpower for start-up and maintenance of the equipment right from project start to finish.

ENIKKOM is proud to be associated with Inrock Drilling System both locally and internationally.

INROCK DRILLING SYSTEMS is a major manufacturer of Drilling Systems, Guidance Systems, Equipment Systems and Drilling fluids. INROCK has consistently maintained an excellent reputation in the areas of safety and environmental management.

For our Directional Drilling projects, **INROCK** provides ENIKKOM with Guidance System, Drilling Fluids and Equipment System and Competent Personnel to handle the down-hole survey works on our projects.

MEARS GROUP, INC. founded in 1970 is an engineering and construction company with over 500 employees encompassing pipeline related services:

Their Engineering/Technical Division provides turnkey pipeline integrity management services, which includes:

- Pipeline Integrity Engineering Testing and Construction Services
- Electric and Power Industry Integrity Services

Their Construction Division provides bellhole excavation, pipeline repair, anodeflex installation, pipeline maintenance support, ILI inspection support and anomaly digs, and pipeline coating and reconditioning.

Their Horizontal Directional Drilling Division is one of the largest HDD contractors in the world, owning 26 HDD rigs working in the pipeline, utility, water and fiber industries. Projects include river, road and railroad crossings, shore approaches, and intersects, installing steel, HDPE and FPVC.

Mears Group is one of the largest directional drilling contractors in the world with:

- **Capabilities of up to 1,300,000 lbs of pullback**
- **Ability to install pipe up to 60 inches in diameter**
- **Completed record-breaking crossings**
- **Specializing in marine HDD shore approaches and water-to-water crossings**

For our Directional Drilling projects, **MEARS GROUP, INC.** has a technical service agreement with ENIKKOM and MEARS GROUP as the leader and innovator in shore approaches and water-to-water crossings, with expertise in marine crossings, **provides ENIKKOM with resources and manpower to meet our project needs in this direction.**

Lakes, rivers, bays, or oceans, ENIKKOM/MEARS GROUP has the CLIENT covered. Working from marine vessels and platforms, MEARS GROUP have successfully constructed highly complex and challenging crossings for landfall sections of offshore oil and gas trunk lines as well as telecommunication and electrical power cables.

Mears specializes in highly complex and challenging marine crossings. Based on their engineering and design capabilities, we use the most innovative technology and installation methodologies to carry out special horizontal directional drilling (HDD) crossings.

QUALITY & SAFETY (Q&HSES)

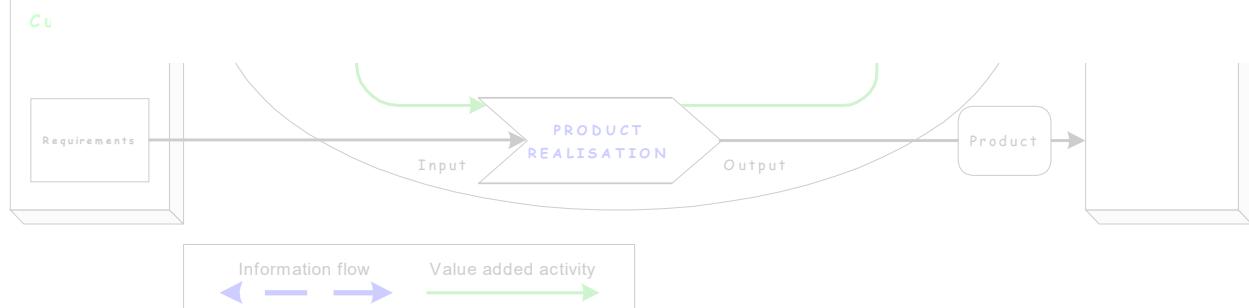
ENIKKOM operates an internal and external quality and safety system in accordance with the latest requirements in ISO 9000: 2000 series on quality management systems.

The documented QA and HSE system, which is adopted as the guidance for success, is a four level model as follows.

- I. **Policy and Authority Statement Manual**
- II. **Quality Assurance and Safety (HSE) Procedures**
- III. **Specific Work Instructions**
- IV. **Quality and Safety Records**



ENIKKOM is committed to reinforcing a 'safety comes first' culture with its employees. Everyday activities are performed using certified equipment and procedures. **ENIKKOM** implemented a new Occupational Safety and Health program (OSH). Two elements of this program are the personal protective equipment and job hazard analysis.





TESTIMONIALS

DFL

we would like to compliment ENIKKOM Construction Company on the outstanding job on the just concluded 36" x 1.5km swamp/river crossing. Their presence and work ethics has really made a huge impact. Impressive drilling work done by your team.

Zakhem

ECL has now successfully completed a number of crossings using the Horizontal Directional Drilling (DD) method on behalf of ZCL. We have found their team to be refreshingly co-operative and attentive. ECL, brings a level of client side understanding to each and every project they are engaged on, this help us to include ENIKKOM as the preferred contractor of choice when considering all projects. We have no hesitation in recommending ECLfor the services they provide.

saipem

We are delighted with our experience of working with ENIKKOM over the duration of our project. We have found all staff from senior management down to the site delivery team to be friendly, cooperative, helpful and very professional. It was a pleasure working with the team and we definitely will look forward to our next project together.

Gramen Petrosive

Enikkom has provided Horizontal Directional Drilling services to our company. having satisfied our requirements for efficient work. This was made easy as the company had the right equipment and team despite the difficult terrain.

INTRODUCTION

Horizontal Directional Drilling Services (HDD).

Horizontal Directional Drilling (HDD) is a method of installing underground pipelines, cables and service conduit through trenchless methods. Horizontal directional drilling is an ideal solution to the problems faced when pipes, cables have to be laid whether in urban or rural areas Instead of digging trenches.

It's efficient in terms of both time and cost.

With horizontal directional drilling, obstacles are no problem – the equipment can be guided over, under or around them, meaning existing pipes, cables and utilities are not disrupted or damaged while work is completed.

An added advantage with this approach is that the site area – and the resulting disruption to roads and other forms of access – is greatly reduced.

The reduction in disruption isn't just a benefit around town; it's ideal when work has to be carried out in environmentally sensitive areas.

PICTURE



Step 1- the first stage of drilling that involves the launch of the BHA through a predetermined design path.



Step 2 – This involves the enlargement of the borehole. This must be enlarged to a suitable diameter for the product pipeline.



Step 3 - this involves pulling the prefabricated product pipeline spool into the drilled borehole.

VIDEO

REPLACEMENT OF 10" X 12km UTOROGU – UPS GAS TRUNKLINE USING CONTINUOUS HORIZONTAL DIRECTINAL DRILLING (HDD) IN OML 34

Enikkom Construction Ltd. is the leader and pioneer HDD contractor in Nigeria. We have completed record-setting crossings in Nigeria using Horizontal Directional Drilling and hold the record longest crossing of 3.1km in Africa using HDD. Yet, every day we strive to improve on our EPC processes and apply international standards to our project management techniques, and in the process, push the horizontal and vertical boundaries of possibilities in the pipeline infrastructure sub-sector.

Subject contract was awarded to Pipeline infrastructure Enikkom Joint Venture, a JV partner of ENIKKOM group in 2021 for the installation of 10-Inch x 12km pipeline from the Utorogu gas plant to Ughelli Pump Station by means of Horizontal Directional Drilling.

Based on evaluation of available documents on the subject project, we came to the conclusion that the installation by continuous HDD will be done in Six sections (DPO to DP5) having 5 intersect drills due to the long distance and 1 single shot drill. When commissioned, the 10"x 12km Utorogu – UPS gas trunkline will be the longest HDD crossing in Africa. This is no mean feat and we take pride in the quality of our delivery.

During the execution of a project of this complexity, there are many risk associated but due to our experience and record breaking history, we were able to access the risk factors and take care of them as we do with every of our projects .

SCOPE OF WORK

- Installation Survey, Design & Engineering of Project.
- Procurement of Line pipe/ Pipe fittings
- Mobilization of equipment and personnel.
- Welding of 12" X 12km Pipeline in different Sections as shown Table D1-5. 100% NDT of the 12" Pipeline welded.
- FJC of the welded joints
- Hydro test welded spools for Installation of 12" X 12km across OML34 from Utorogu Gas Plant to UPS PL Delta State using the Horizontal Directional Drilling Method.
- TIE IN
- Commission the installed pipeline
- Cathodic Protection
- Demobilization.

CONTINUOUS HDD

A CHDD crossing of this length is only made possible by introducing sectional “tie in points” at designated areas along the Right of way wherein the opposite ends of the HDD spool are welded together or “Connected” to form a single, continuous spool. Further still, the process of successfully connecting these HDD spools includes but, not limited to the following;

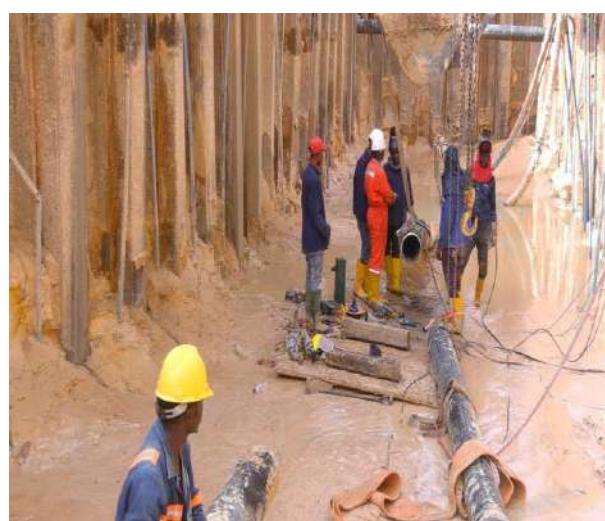
1. Construction of cofferdams to enable us reach the Tie in point of 10m.
2. The Excavation of pit to rach required depth
3. The Dewatering as area a water logged.

Every stage of this process presents a wide range of challenges. At Enikkom Construction Ltd, we live for such challenges. A typical challenge faced in cofferdam construction is the seasonal change in the level of the ground water table at an unforeseen rate. Cofferdams are by nature temporary

structures built to keep water away from the construction site, so that execution can be carried out on a dry surface. They are mostly constructed in adverse conditions and are subject to diverse load pressures, significant changes in subsoil conditions, possible erosion as well as fluctuating ground water ingress. To solve this problem, ample provision was made to account for deviations in soil test analysis as well as extensive dewatering systems so that the final structure is constructed in line with world best practices. We latched on to our wealth of experience in River and swamp activities and introduced dewatering system made up of well points, jetting pumps, electrical water pumps etc. to constantly dredge the cofferdam to maintain a dry and HSE compliant work area. As a result of this dewatering system, we are able to carry out excavation to 8m – 10m agreed depth for the various Tie in points and successfully carry out welding, radiography and coating inspection on our HDD spool in safety.

At Enikkom Construction Ltd. we help our clients compete on the global scale with accelerated revenue growth as they can now make more accurate, long-term forecasts of regional crude and associate product demand caused otherwise impacted by man-made & environmental events. We also help them promote stable processes, mitigate supply chain risk, and improve resilience in our clients' operations in the most volatile and hard-to-reach areas. We take pride in our ability to rapidly mobilize equipment, personnel and materials to tackle challenges as they come. This tight "feedback loop" helps our project management team collaborate better, and react quickly to clients' needs and market changes. On every project, we make sure to constantly improve on our past record for mobilization in the face of challenges. Indeed, this agile approach to engineering project management is at the heart of our operations and is our guaranty to our clients of top-class, safe and sound execution of EPC projects.

PHOTO GALLERY



TECHNICAL OVERVIEW

Obiafu-Obrikom-Oben (OB3)48" Gas Pipeline Project

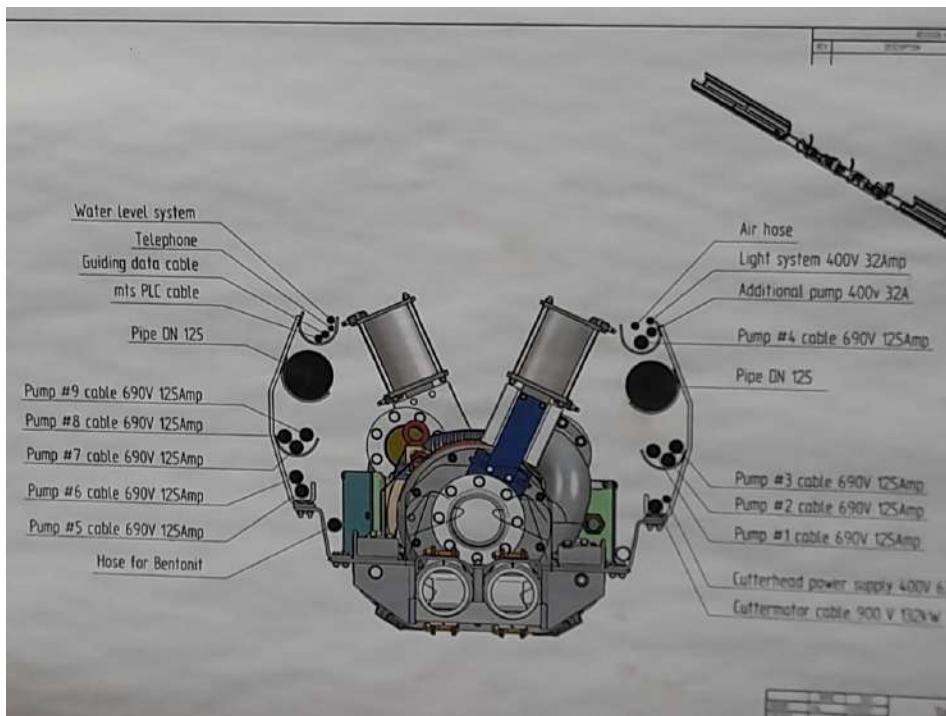
River Niger 1,835 m crossing

INTRODUCTION

HDDT/Enikkom Nigeria Ltd was awarded the 1.835m ,48" dia. Pipeline River Niger crossing to transport gas from the eastern end of the river to the western end using a combination of Horizontal directional drilling (HDD) and Direct Pipe installation (DPI) Trenchless technology.

HDD Rigs (A 500T and 300T) and crew mobilized in Q4 2020 successfully drilled the pilot hole with intersect at KP16, and reamed to 36". The HDD crew was thereafter demobilized in December of 2020.

Set up for Direct pipe jacking system commenced in January 2021 with construction of a solid structural base to withstand load in excess of 700 kN and subsequent mobilization to site of the crew from MTS Germany in Q1 2021.



Internal assembly of A TBM

The Jacking system was designed to clamp a pipe length of 300m at every thrusting. The 1800m pipeline already welder by previously contractor has to be cut in 300m spools.



DPI Jacking system set up

PECULIAR SITE CHALLENGES – PART 1

At the commencement of operation drive on 15th of May 2021, stopped at 30 m when the push load went up, observed the Thrust boing machine (TBM) was dropping. Had a drop of 1m. Check on equipment showed bolts holder equipment together shared. Bolts replaced and connection piece fabricated and welded in place inside the TBM. At restart of tunnelling operations after repairs, angle was observed to be dropping at 30m. At 40m, pushing load went to 170 tons as against 30 tons planed and also a drop of 3m below planned profile. Decision to terminate operation and review situations. TBM was pulled out.

EXECUTED STRATEGY ADOPTED TO MITIGATE KNOWN CHALLENGES – PART 1

- Installation of 60" dia. Casing pipe from the front of the Launching shaft to a distance of 48m and depth of 10m at the deepest.
- Ground grouting from the tip of the casing pipe (48m from shaft) to some meters, approximately 30m further to the river bank
- Improved steering head weight with 3 no. additional empty trailer to bring the TBM to near zero buoyancy
- Ground radar penetration survey carried out to re-establish the geotechnical survey across KP 15 – KP 17



Installation of 48" dia. Casing pipe

With the implementation of highlighted actions and modifications, product pipe pushing operations resumed effectively on the 28th of December 2021.

PECULIAR SITE CHALLENGES – PART 2

After restart of operations, it was observed at 178m into the operations that slurry pumps were found leaking excessively, the pumps were modified under OEM instructions and again at 188m into the operations the offending pumps were rebuilt again at this time and all new pumps were ordered from the supplier while operations continued

Tunnelling continues up to 421m at 220 tons push force from the 190 ton force required before the tie-in, this was not deemed unusual due to an additional 310m string adding to the drag on the pipe. However each shift an increase in push force is detected, all lubrication parameters are scrutinized and found correct, no change in formation was perceived. At 431m push force rises to 240 tons, clamps are slipping due to the condition of the pipe and glazed over. Some courser river gravel was becoming more evident over the shakers.

all lubrication lines were checked internally on the machine, the front lubrication nozzles were manually closed to direct all lubricant away from the head due to the theory of underground water washing away the lubricant, one of the rear nozzles was blocked and subsequently cleared and re-installed, all parameters were as expected.

slipping clamps were cleaned and tunnelling recommenced, additional lubrication was pumped into entry seal and to the machine, clamps failed again and tunnelling unable to start due to

clamps moving at 270 tons. Even though no tunnelling had been carried out spoil continued to be separated over the shakers consisting of at least 4m³ of course sand and gravel indicating material is being washed into the cutting chamber whilst static

INVESTIGATION

Removed the entire launch seal and built a 100% polymer and lube fluid, the theory was to replace all the bentonite from the machine along the tunnel. However after pumping over 30m³ there was no bentonite appearing at the launch seal and the pressure in the chamber did not increase. The operators operated the interjack cylinders inside the machine to manipulate the area around the machine but it was noticed that after pushing 20cm the cylinders were put into float, (a neutral state where oil can flow to either end of the cylinder), the cylinders snapped closed. This is another indicator of some substantial hydraulic ground pressure and absolutely not normal. It appears that all of the lubricant pumped has been washed into the formation. Investigation of the Island within the 420m to 450m section of the ROW (The tunneled 30m) revealed some cave in on the surface



Caved section of on the island along the ROW

CAUSES

Careful evaluation of all the possible causes revealed that the fault is most probably attributed to lose ground formation not captured in any previous Geotechnical Soil Investigation.

EXECUTED STRATEGY ADOPTED TO MITIGATE KNOWN CHALLENGES – PART 2

- Deploy and Execute High Scan GPR to isolate particular soil type.
- Carry our Scan across the entire ROW and further bore boles along highlighted trouble spots from the scan results.
- Grout/Recondition the highlighted unstable sections along the ROW.

LESSONS AND OBSERVATIONS

TECHNICAL OVERVIEW

As Nigeria's foremost horizontal directional drilling (HDD) company, Enikkom Construction Ltd. is charged with installation of pipeline infrastructure in some of the country's most volatile and hard to reach areas. Thanks to our tested and trusted HDD engineering & Project management team no area is too hard to reach or volatile to deliver excellence to our esteemed customers. This was the case on the 900m X 12" Steel Pipeline And 900m X 6" Steel Casing for FOC Across Orashi River by HDD And 400m X 12" Steel Pipeline And 400m X 6" Steel Casing Pipe for FOC Across Mbiam - Yenagoa Road and Epie Creek by HDD For Shell / MORPOL Engineering Services

PECULIAR SITE CHALLENGE & STRATEGY TO MITIGATE KNOWN CHALLENGE

On this project, we faced challenges ranging from unstable terrain during site setup to accessibility issues for our supply chain operations as a result our location on the Epie creek. To tackle these and many more challenges, we deployed a mix of conventional and non-conventional techniques such as

- fabrication of skids to enable slide in equipment through terrain
- Deployment of additional heavy-duty machinery (Light weight Excavators, loaders etc.) to overcome the terrain.
- We also engaged with our host community to provide local artisans for our supply chain team who were a great help in navigating the Epie creek.

In doing so, we maintained a near-impeccable safety record & boosted the local economy while delivering the project.

Such commitment to delivering world class quality to our clients is a testament of our sheer grit and passion for excellence and enhanced pipeline security in Nigeria. At Enikkom Construction Ltd. we understand our clients' needs to combat pipeline vandalism and sabotage & we make it our duty to match these needs with laser focused planning and execution.

PHOTOS









LESSONS & OBSERVATIONS

INTRODUCTION

Drilling beneath bodies of water for HDD (Horizontal Directional Drilling) comes with diverse challenges that vary from one project to another. Consequently, Ejirin HDD project located on the Lagos lagoon presented its own peculiar challenges and it was another experience entirely for ENIKKOM who recently finished a similar installation of 36" x 1.5km crossing by HDD within the same axis.

The Lagos lagoon is approximately 50 km long and up to 13 km at its widest point, separated from the Atlantic Ocean by a long sand spit 2 to 5 km wide, which has swampy margins on the lagoon side. Its surface area is approximately 6,354.7 km². The lagoon is fairly shallow and is not plied by ocean-going ships, but by barges and boats. The lagoon receives the discharge of the Ogun River and the Osun River. the crossing channel then goes through the pass between both river banks termed the Pipe side and Rig side.

PROJECT CHALLENGE – Part 1:

Owing to the terrain in Ejirin, dredging had to be carried out first for stability before the rigs could be set up for drilling. Infact, the reclamation was done up to an average of 6m depth before stability could be achieved at the exit point (pipe side) which took months of day and night dredging and for wants of time.

The long pilot bore got off to a good start, An American Auger 300ton (600,000lb) rig was used to drill the pilot shot from the exit point. The 6-5/8" pilot bore proceeded down at desired angle and depth below the swamp and river bed, and proceeded to the entry point.

EXECUTION STRATEGY ADOPTED TO MITIGATE KNOWN CHALLENGE – Part 1

barge were used as the platform for setting up the rig and support equipment at the entry point (rig side).The barge hard to be reinforced using piles and bracings

Pictures

PROJECT CHALLENGE – Part 2:

The pilot hole was completed in 24 days (while trying to stabilize the entry point due to bad ground/terrain) including 16" casing installation for stabilization and mud control then proceeded with various reaming passes (16/18", 22/24", 28/30", 34/36", 40/42", 46/48" and 48" clean pass) but difficulties arose with 48" back reaming to enlarge the hole.

HDD drill pipe end was decoupled during drilling operation about 50 meters away from HDD entry pit. The pipe had gone to between 10 to 15 meters depth under the river bed. Using a high tech metal detector to determine the point and depth of decoupling, the pipe was located at about 13m under the river bed under the mud of the swamp section. In such situations, the hole may be abandoned and a new bore made adjacent to it. However, in this case, the job would have had to be re-permitted, taking as long as 6months. That couldn't be afforded, because it would cause us to miss the contract's completion date. Liquidated damages would be assessed for each day past the deadline, and the daily cost would be substantial.

EXECUTION STRATEGY ADOPTED TO MITIGATE KNOWN CHALLENGE – Part 1:

To solve this problem, we decided to build a coffer dam around the area of decoupled drill string and introduce divers with specialized equipment to hook up to the tail end of the loose drill string. But first

the area needed to be swept with a dredger to a depth of -6m. This will reduce the depth of coffer dam to be installed through the mud to – 7m and then the precise location needed to be known so a magnetometer probe was introduced. Several grid-lines transverse to the axis of the drill-string was ‘run’ and fixes made on the sensors ‘hits’, with several hits plotted, the actual longitudinal axis of the pipe is determined. The survey team now plots the longitudinal axis of the pipe (drill sting) into their equipment and runs the magnetometer along this axis until they detect the end of the pipe. And then the dredger moved in and commenced sweeping. The cofferdam is built to give workers a dry work environment to allow for the retrieval of the buried drill string which would otherwise be difficult. To enable quick retrieval process, a 15m x 72” Ø casing was used in place of building a cofferdam. Prior to commencing positioning of the coffer dam (15m x 72” Ø), a confirmatory survey was be carried out and the edge of the pipe marked and reconfirmed. This is then further confirmed by blowing air through the pipe from the other end of the drill string.

On installation of the cofferdam, the mud inside is pumped out by means of an Electric Toyo Pump and Water is simultaneously pumped into the coffer dam as mud is being pumped to ensure pressure equalization within the coffer dam. Once the cofferdam has been fully installed to 13m, Divers will then dive in and manually probe the bottom to manually locate the pipe which should be +- 1m from the edge of the coffer dam. The actual distance is measured. Divers will then dive in and clean the end of the pipe and screw on a prefabricated cap to the end of the unscrewed drill string. A 40-ton Swivel with one end attached to a cable is then coupled to the end cap on the drill string. Once the tail end was hooked up and attached to a 500ton rig, tripping out drill rods began to exit the 48” reamer. Back reaming was resumed. The HDD segment was completed prior to the deadline.

PHOTOS

INCLUDE PHOTS

LESSONS AND OBSERVATIONS

Even as a leading HDD contractor in Nigeria, we cannot control all of the trials and tribulations that may come with drilling activities. However, on every project it is our goal to demonstrate to our clients that we can be trusted to overcome these challenges as they occur. Indeed in the HDD business, it's not a matter of if, but when. Everyone has been stuck at one time or another. It takes finesse, experience and luck to get free.

TECHNICAL OVERVIEW

Introduction

Prior to mobilizing to location at Ekioadolor Benin state,, we had carried a further soil geotechnical survey as a result of the Oceanic Bank/Agbor Road Crossing Experience. In addition to the rock coring test, we carried out Soil Resistivity test (both out of Scope Test) to enable us determine the type of soil under the rock across the entire ROW. After a review of the results, it immediately became obvious that the Ekiadolor crossing was not a normal crossing. The manual soil bore equipment used couldn't penetrate beyond 30m at the deepest point. It was then obvious that we were dealing with some form of rock.

The result showed a complex soil mix not usually advisable for HDD. Having profiled the soil strata on both sides of the valley at depths of 80m the crossing was designed and detailed engineering carried out. Choice of tools and additional equipment were made and subsequently procured as it became obvious that the normal tools used in the other crossings will not work with this crossing.

Peculiar Site Challenges – Attempt 1

- Deep Valley - Difference in elevation of 40m between highest and lowest Points along the ROW.
- Very Corrosive Soil. Extensive wear on reamers, pumps and rigs, mixing and recycling units. Also wears out the drill pipes collars requiring extensive inspection and recut when found defective ([input reamer and impeller pictures from Ekiadolor](#))
- No direct access between exit and entry points because of the valley. Between Very unstable soil strata.
- The Northern and southern banks of the valley are very steep and just prior to our commencing site investigations had extensive erosion control works carried out at the banks in steps. Hence impossible to get motorized equipment into the valley without damaging the erosion remedial works carried out at the banks. ([Input Pictures of Valley](#))
- We were only limited to coring at both exit and entry points.
- STUCK: The 24" and 36" reaming passes were also successfully completed using the modified 24" and 36" Hybrid Reamers. However, at about the same area where the 42" reamer eventually got stuck, the 24" and 36" reamers stopped temporarily but continued turning when a specially formulated chemical pill was pumped and circulated around the reamers.
-

Execution Strategy Adopted To Mitigate Known Challenges

- Engineered crossing Profile such that the 80% of the horizontal section of the profile goes through the Shale rock section (Stable Soil) of the ROW
- Core the rock formation to a depth of 80m taking samples in core glasses to aid drilling operations
- Stay a minimum of 20m below the stream/river bed.
- Mobilize bigger capacity mud mixing and recycling units (10,000 ltrs capacity mud mixing and recycling units) at both exit and entry locations.
- Back up most of the critical equipment's, including additional equipment mobilized to site to improve mud handling capacity.
- Install a water line from the river to the rig side to ensure adequate water availability We had 2 No Deep-water wells at the rig side and 1 No Water well up the hill at the buoyancy

end. This still was not enough because of the loss of returns into the fault. Hence the need for back up water from the stream.

- Procurement of fit for purpose special Hybrid reamers from
- Procurement special Rock Drilling Tools, Mud Motors, reamers

Lessons and Observations from Attempt 1

On failing to recover the stuck 42" reamer after the drill string broke, we did an in-depth analysis of the events leading to the reamer getting stuck.

In order to live up with the challenges posed by this peculiar crossing, we had to procure a lot of additional equipment, tools and consumables. We also lost the American Augers DD 440T-drilling rig in the process. This equipment was damaged beyond repair and was written off by American Augers. We also experienced Very High level of wear and tear on our equipment. In some cases reamers were written off after a single reaming pass. Drill pipes that were normally inspected at the end of each project were being inspected after each reaming run. We also experienced very high wear on the subs and drill pipes leading to re-cutting of the drill pipes several times and in some cases outright replacement

Peculiar Site Challenges – Attempt 2

After the first attempt, an in-depth review of the whole process was carried out, failures and further challenges highlighted. A new strategy was then adopted to ensure a successful second attempt.

Having drilled the failed crossing through the perceived most stable section of the soil and with the broken pipe string still stuck in the hole, the challenge became where to drill the second pilot hole. We proffered various options. It was agreed to go deeper under the 10m rock bed. We also had the following additional challenges to contend with:

- The Mud fracturing out at the valley could overflow the bund wall, hence it was decided to include a mud return line to be used to pump mud back to the rig side for cleaning and recycling.
- Experiencing heavy losses down hole. Special Mud pills pumped down hole could not fully mitigate this peculiar challenge.
- The water borehole became entirely inadequate since we needed to mix mud more frequently.
- Very sticky and binding clay on reamers when it came out
- Water ingress into the hole.
- New proposed depth of 80m posed pumping challenges because there was no pump at site with adequate capacity to pump the required volume and pressure through a head of 80m
- Experiencing downtime in mud mixing because of losses being experienced downhole.
- New drill pipes were required to replace those lost in the hole during the first drilling attempt.

Execution Strategy Adopted To Mitigate Additional Challenges

New drill pipes procured and delivered to site. Total length of 3,000m. Increase mud-handling capacity. We had 5 no Mud mixing systems at site. Planned to use MPR6,000 as primary mixing and pumping units. Mobilize additional 2 No mud mixing tanks, one to serve as active mixing tanks and the other as storage tanks. Both tanks have bigger venture and their roles could be interchanged as required. This brought the total mixing tanks at pipe side to 3 as against one used previously. 2 No Mixing and cleaning systems to be used at pipe side for cleaning of the return mud from pipe side. The MCM 4000 served as primary cleaning system for the pipe side while the MCM10,000 served as back up cleaning system for both sides.

- New profile is 10m deeper than previous profile with an approximate 35m of cover. These greatly reduce the risk of water ingress into the hole.
- Used new Bentonite - Gel TEQ with the following properties:
 - High Rheological Parameters for effective cutting, transport and hole
 - Viscosifier and Water Control
 - Torque and Drag Reducing
 - Improves Borehole Stability for easy well installation.

- Provides lubricity and stability in water sensitive formations.
- Procured new specially reamer design (36", 42" 46" and 52"). These reamer designs are designed to handle the rock, sand, coal and clay formation.
- Secure the services of a Very Experienced Mud Engineer, in this case an experienced drilling manager with over 20 years of experience and is a lecturer and consultant to the major drilling company's.
- Procure mini mud lab equipment and set up a mini lab at site.
- Increase the no of mud pumps and connect 2 pcs in series to give the required minimum pumping capacity of 2,500m³ at both rig and pipe sides. 3rd pump at each side to serve as back up.

Lessons and Observations

After having the 2nd drill string stuck and having failed with all the attempts at unstocking the reamer and drill string it became obvious that we were still missing out a key challenge. Every strategy that was put in place greatly improved the drilling process yet the 2nd drill string got stuck during the 24" reaming pass. Further analysis highlighted the following:

- There are no doglegs throughout the drill path for both stuck strings.
- The 24" as well as the 42" reamers that got stuck seemed to have got stuck in the same soil section. The most likely problem seemed to be drilling fluid management issue. The area in question seemed to be mainly loose sand, just before 6m clay sections interplaying with the 1.5m thick rock tables. It was difficult to gauge the exact position as further boreholes samples were taken at 100m intervals. Hence the tendency to run into difficulties change from high viscous fluid to low viscous fluid exiting from the sand into the hard clay cum rock section.
- In order to come up with specific solution to the problem, the need arose to carry out a further soil test that will clearly mark out the exact location of the various soil strata marking out the various interface points through the drill path.
- This will enable the mud engineers closely monitor the mud viscosity more closely and adjusted to suit as required.
- There are too many interphases encountered at this depth. There is need to select a bore path that reduces the no of soil interphases to manage and reduce the rock section as much as possible.
- Retrieval of the 24" stuck and string may take quite a while if at all, the prospect of attempting retrieval for 2,3,4 weeks then finding out it is unsuccessful then having to start all over again would only prolong the successful execution of the project.

Peculiar Site Challenges – Attempt 3

At this point it was clear that the challenge with subject crossing is the section from the exit point to the first rock section. Careful analysis of the all the drill logs showed that the section of the ROW beyond the 1.5m flat rock coming from Pipe Side (Point B) towards Rig Side (Point A) as the drill bore goes through the rock section was very stable limiting the problem to the exit side.

Additional Site Challenges

There was need to carry out further soil test but the major challenge was determining the appropriate test for subject site condition. Further bores clearly showed that we were dealing with loose sand and the problem always occurred either just above the interface between the Very loose sand section and the hard clay/rock interface area or below it (same Soil Condition). A soil test that will clearly highlight these interphase areas became mandatory. The initial soil test had challenges, as we initially could not bore through the rock formation. Geophysical electric mapping which we then adopted also had the following challenges:

- a) The geomorphology of the area was steeply undulating with hills sharply ascending and descending respectively.
- b) Very deep man made ravines occasioned by sand winning exist on one side of the pipeline route around the valley of interest.
- c) Wire meshes were used to construct terracing down the valley from crest to crest, area of coverage of more than 2,000 m².

The aforementioned conditions posed challenges to getting enough spread length for the vertical electrical sounding. The intended perpendicular mapping of the route at intervals down slope became impossible. These conditions limited the geophysical survey.

We needed a method that will achieve the following:

- a) Characterize the subsurface based on its electrical resistivity distribution
- b) Determine the lateral variation of subsurface materials and its engineering implications.
- c) Itemize the possible reason(s) why there were losses of circulation/stuck pipes during the previous two attempts.
- d) Further shed light on possible regions that required more engineering precautions.

After extensive review of available options, it was finally determined to carrying out a further geophysical investigation using 2D and 3D Electrical Resistivity Imaging. A professor in Ogun State University had over the years gathered enough soil data carrying out 2D and 3D Electrical Resistivity Imaging that he had greatly improved his accuracy in analyzing soil strata using reports from soil Electrical Resistivity Imaging. Further discussion with him also highlighted the fact that the Bentonite already soaked into the ground from previous drills would aid the soil analysis, as that would better

highlight the soil strata signature. This procedure also met all the above listed criteria's. In June 2017, this technology was deployed in characterizing the sub surface.

The report finally shed more light on the lateral variation of the sub surface materials and its engineering properties. It enabled us Map the lateral variation of the subsurface variations at the pipe side (See Attachment A3.4) thus enabling us come up with specific solutions.

- From the interpretation and analysis of the geophysical data obtained from the site at Ekiadolor, Edo State alongside the geological and hydro-geological facts available, the following conclusions were made: -The subsurface was characterized into four main regions

based on the electrical resistivity signatures. The first region comprises of Lateritic (Topsoil) Soil, the second region is composed of Sand, the third region is clay (localized in the neighborhood of the river bed) and the fourth region is the lithified sandstone region (characterized as Bedrock in the boring).

- It was observed that there are three main vertical structures along the profile (in the neighborhood of the river bed) indicative of fault in the subsurface.
 - The first fault is within the lateral distance of about 310m from the entry point. The second indicated fault is within the lateral distance of about 459m from the entry point.
 - The third indicated fault is within the lateral distance of about 600m from the entry point.

The loss in circulation which aided the getting stuck of the 24" reamer and drill pipe string can be associated to the presence of the subsurface faults. **These presences of faults (opening) in the subsurface are highly inimical to drilling operations.**

Execution Strategy Adopted To Mitigate Additional Challenges

Having finally determined the main cause of failures of the previous drilling attempts, we needed to adopt a strategy that would ensure success of subsequent drilling plan. A detailed strategy was developed for the phase 3 of the project taking into considerations the lessons and challenges from phases 1, and 2.

Careful review came up with the following strategy: -

● Staying at the current depth of the crossing would require a huge increase in mudflow in order to create enough velocity to carry cuttings successfully to the surface for removal bearing in mind the anticipated losses that would occur as a result of the 3 No Fault Lines across the ROW. Hence the strategy was adopted to install the crossing at a high drill profile as possible to alleviate some of the fluid velocity challenges. Also raising the level of drill profile would also keep the profile out of some of the troublesome rock sections and sections with multiple mix of different soil strata. This had the advantage of making the operation more manageable. Consequently it was agreed to install the new line at a depth of 65m.

- At an elevated depth of 65m, it meant that we were above the main rock bed and underneath the 1.5m thick flat rock bed. Also with the knowledge of 3 fault lines, frac out at the valley became inevitable. This strategy was then adopted to mitigate this new challenge based on the Oceanic bank 1.9km x 36" Crossing experience where we stayed above the 1.5m flat rock bed and had multiple frac-outs along the ROW. We consequently modified the Ekiadolor HDD valley mud mitigation plan to include a mud cleaning and recycling equipment, Mud Pumps, Trash pumps etc. (See attachment A-3.6)
- Provided for a minimum of at least 2500 tons of Bentonite as it was determined that we would need to pump at least 2000tons of special bentonite slurry mixed with special chemicals down hole to plug the fault lines before ever we would begin to get returns at the valley frac out point or at either the exit of entry sides.
- Move the exit point 145m forward from the 1st drill exit point (Point Marked As **EXIT POINT** on Attachment A-3.1) to reduce the length of unstable soil at the exit area we had to contend with.

- Monitor Mud viscosity a lot more closely and adjust to suit especially during reaming passes through the exit area.
- Procure an improved set of down hole tooling from HDD Thailand. This will benefit the crossing massively increasing the hole stability (see attachment A3.7 for tooling from HDD Thailand).
- Replace the 100-ton Rig at the exit side with a bigger 300-ton rig. This way we would be able to ream from both sides as required.
- With continued challenges, even with all the mud management control procedure put in place at the exit area it was determined that the Soil Strata within this section of the ROW, which is made up of mainly VERY LOOSE UNSTABLE SAND, can not be drilled. We subsequently put a plan in place to install a casing through the remaining Unstable section of the ROW at the Exit Side after bypassing 145m of this section of the ROW by moving the rig forward.
- Consequently a plan was put in place to install a 42-inch casing to stem collapse of the loose sand section.
- Plan for buoyancy control using a 100-ton rig spread was also put in place. We also increased the mud handling and storage capacity as it was envisaged that we would not have returns for the first half of the drilling operation.

Lessons and Observations

- Drilling went very well as planned until we got to 48" reaming pass.
- 16" to 48" Reaming passes were carried out in less than 4 weeks.
- After we abandoned the installation of the 42" casing, we ran a 36" clean pass through the hole. We only encountered soil collapse within 200m from exit point where it was taking an average time of 40mins to ream a joint; thereafter it took less than 5 minutes/joint to pull the 36" reamer through the rest of the hole.
- Shows the difference in depth between the profiles at the time of terminating the 42" casing installation against original pilot-hole profile for phase 3. There was a difference of 4.11m in elevation between the two profiles at the deepest point.
- Shows bending radius of R216.26, R246.68 and R200.04 as against the minimum bending radius of R800 and Design Radius of R1000 hence the decision to abandon the profile.

Peculiar Site Challenges – Attempt 4

Having determined that we still have a very stable 42" hole across 80% of the ROW from the rig side, the need arose to find a solution that will take advantage of the existing drilled hole rather than drill a new pilot hole. Beside there was nowhere to drill a new line on the same vertical as we have already drilled 3 different profiles on the same vertical axis.

Also, the consensus was that any new pilot hole must avoid the 145m- collapsed section. Consequently, it was decided that most option would be to install a 48" casing which the client was willing to provide. Drilling a new pilot hole to intersect into the existing 42" hole was adopted as a better option than to drill a new pilot hole.

Additional Challenges

At this point the challenges has become how to install the 48" casing to perfectly align with the existing 42" hole the following options were considered: -

- **Using a Ground-O-Ram hammer** to hammer in the casing. 60m of casing will be required in this case. This however had a peculiar challenge that it will be installed in an angle of 14 deg to the horizontal and we have no means of marking out the exact location with a tolerance of less than 1%. It was determined that the impact of the hammer will trigger the collapse of the stable/ open section of the already reamed 42" hole. We therefore discarded this option.
- Using the combination of the 380 Ton pusher at the pipe side and 500ton drilling rig at the rig side to install the 48" casing. This would have worked perfectly except that the pusher has a clamp of 60" diameter and would require a 48" adapter. We only have a 36" adapter for pusher and would take 12 weeks according to the manufacturer (Prime Drilling) to make the adapter. This option was therefore discarded.
- The 3rd option was to install the 48" casing using a thrust bore machine. This looked plausible to first but had a challenge of being installed at an angle of 13 deg to the horizontal. Without a guide in front the nose of the pipe will drop during installation and go out of alignment with the existing hole. This option was eventually selected and the following strategy developed and implemented as articulated below.
- Also, on aborting the pullback on 10th December 2017, a new challenge surfaced when the 42" reamer stopped at the mouth of the 48" casing and couldn't come out while trying to retrieve the 42" reamer.
- On the 27th of January 2018, we ran yet into another challenge. While extracting the 48" casing and the reamer (the adopted strategy was to extract them together as part of the reamer assembly was already inside the 48" casing thereby preventing the loose cased section from collapsing on the reamer were the casing to be extracted alone) the drill string from the 500ton rig at the rig side unscrewed from the reamer. After pulling the casing and the reamer, the affected section collapsed and again we lost the hole.

A4.3 Execution Strategy

- A new pilot was design to start from 145m from the 3rd existing point shown as Entry Point on Attachment A4.2. Leaving an unstable section of the ROW of 48.8m.
- The new profile was design to intersect the existing 48" hole at a point 217.74m from the Entry Point at pipe side.

- The casing installation was designed to protect 72m section of the crossing profile from the new Entry Point to the intersection drill profile. Approximately 55m of casing were installed leaving 16m free space required for the thrust boring machine.
- Since the space of the pipe is 48" X 900 pound/ ft thrust boring machine was chosen. This eliminated the use of adapter where the 60 X 900 pound/ft Thrust boring machine were to be used.

Engineering the installation of the 48" casing was a major challenge. The thrust boring is usually used on the horizontal surface and does not have the accuracy required in this situation as we were targeting to fit a 55m casing at an angle of 13 degree into an already existing hole. The weight of the pile alone will drop the edge of the casing.

We had to come up with a procedure to eliminate misalignment. This is because as little as 1 degree misalignment will deviate the edge of the casing 72m down the end of the casing by as much as 6" to 8". This will make it impossible to pull the 36" pipe through considering that the reamer in front of the casing is 42" and the internal diameter of the pipe is 46". A very complex and delicate procedure had to be put in place to ensure success. This procedure required using the combination of the 500ton rig at the rig side, the 300ton rig at the pipe side and the 900 pound/ ft thrust boring machine.

To achieve this, a dummy pipe was designed with a 42" X 1" heavy wall pipe built up to 45" with strip of 1½ " plates. This was inserted into the 48" diameter casing pipe with internal diameter of 46". A 46" diameter reamer was then attached to the front of the casing with 250ton swivel between the dummy guide and the reamer. This ensured that while the reamer is rotating and cutting a 46" diameter hole the dummy pipe which is 24m long, does not rotate. The trail drill pipe will run through the casing with the end covered with a screwed cap attached to the sling wire. The sling wire was then attached to the 300ton rig behind it.

The strategy here was to drill 1 joint (10m) using the 500ton at the rig side and keeping tension on the string at the pipe side with the 300ton rig. After 10m of 26" reaming, the cable is disconnected at the 300ton rig at the pipe side and the thrust boring machine is positioned onto the already aligned thrust boring machine rails positioned and welded to the base plates in the ditch. The cable is then hooked round the thrust boring machine and connected back to the 300ton rig with the aid of the thrust boring machine the 48" casing is pushed in with 1m section of the dummy pipe pulled into the hole as a guide for the 48" casing. During the casing installation both the rigs hold the pipe to avoid buckling of the drill string. The planetary motor on the 300ton rig follows the movement of the thrust boring machine while maintaining tension. There must be seamless coordination between the two rigs and the thrust boring machine.

Therefore, the cable is disconnected from the 300ton rig. The thrust boring machine removed, a new 48" pipe positioned in place and welded and radiographed. Thereafter the same procedure is repeated until the casing pipe is fully installed.

When we encountered the challenge of the reamer hooking to the end of the casing we were faced with the following options

1st option is to well a 36" pull head behind the 60m spool attached with the pull head and pull all the way out to the rig side using the 500ton rig. This had the advantage of acting as a clean pass and in the event of coming out at the rig side will be a confirmation that the 36" pipe was good to go. Also, we could always pull the dummy back from the pipe side if we encounter a collapsed hole.

2nd option was to extract the 48" casing, pull out the pull head and reinstall the 48" casing. Reinstalling the casing ran the risk of misalignment as the head of the casing was only 20m away from the hard section and there was a risk of the case section collapsing completely and the reamer not able to find the hole.

3rd option was to extract the 48" casing, pull out the pull head and dig out the loose sand section that was cased.

We finally adopted the strategy of extracting the casing and digging out the cased section as it was clear it was going to collapse on extraction of the 48" casing See attachment P-4.12.

When the drill string unscrewed on 27th January 2018 and we lost the string connection between the rigs, we were again faced with two options as follows: -

Run a bull nose hole finder through the collapsed section to reacquire the hole, excavate out the previous cased section of the ROW 45m long, slopped to a depth of 12m or set up a complete pilot assembly and drill a pilot hole through the collapsed section and run it all the way to the exit at the rig side.

We finally adopted a strategy to run the bull nose first and in the event that did not work after 3 days abort and run the pilot hole full probe. This option was better as it was going to take 3 days to set up the pilot hole assembly.

We then commence running of bull nose while setting up the pilot hole assemble. On the 3rd day when we are not making progress reacquiring the hole with the bull nose, we commence the pilot hole drill and reacquired the hole and pushed the drill bit all the way to the 500ton rig side. We then reconnected the two rigs and were ready to go. This process also confirm to us that the rest of the hole was intact as the pilot hole readings obtained with this run was in alignment with the original pilot hole for this phase.

PULL BACK OPERATIONS VERY SUCCESSFUL

INTRODUCTION

Guided Boring (Thrust Boring).

Guided Augur Boring is a precision approach to subterranean installations. Rather than cutting a trench, the machinery can be operated from a shaft or pit, meaning it leaves very little footprint. Disruption on-site is kept to a minimum.

Precision is achieved due to the machinery being guided by laser. It's a method that is quick, safe and versatile.

Additional benefits include that surface obstacles aren't a hindrance and other existing utilities aren't affected. In a busy, urban setting, guided augur boring has to be the preferred option. It's faster, less expensive and presents fewer hazards than conventional subterranean excavation methods.

PICTURE

VIDEO

INTRODUCTION

Micro Tunneling – Slurry Spoil Removal System.

Microtunneling is a trenchless construction method used to install pipelines beneath highways, railroads, runways, harbors, rivers, and environmentally sensitive areas. Microtunneling is defined as a remotely-controlled, guided, pipe-jacking operation that provides continuous support to the excavation face by applying mechanical or fluid pressure to balance groundwater and earth pressures.

PICTURE

VIDEO

INTRODUCTION

Horizontal Boring (Hole Hog).

Horizontal Boring or Hole-Hogs eliminate the need to break pavement or disturb landscaping from trenching or open cuts. Hole-Hogs breakthrough the ground while going UNDER roads, driveways, sidewalks, parking lots, runways, foundations or virtually any obstacle.

The Underground Borer is used to bore a hole underground between two points without disturbing the surface ground. This is a cost effective method for rehabilitation or restoration that causes minimal disruptions to landscapes, buildings or traffic flow.

Horizontal Boring also simplify life for trenching, excavating, plumbing and heating workers, as well as pipeline, boring and landscape contractors.

PICTURE

VIDEO

INTRODUCTION

Pipe Ramming (Casing Installation).

Pipe Ramming is a process where steel pipe is installed with a pneumatic hammer Powered by compressed air. the ramming tool attaches to the rear of the casing or pipe, pushing the casing into the ground with repeated percussive blows. As the pipe rammer pushes the pipe through the soil, rocks, boulders and other obstacles are “swallowed” into it. After installation is complete, spoils inside the pipe are forced out with compressed air. This pipe ramming method provides accurate trenchless casing installation in a wide range of soil without surface slump, making it ideal for installations under railways and roads. Pipe ramming tools are proven effective for horizontal, vertical, and angled applications

PICTURE

VIDEO

INTRODUCTION

PICTURE

VIDEO



Foremost Indigenous Trenchless Engineering & Construction Company in Nigeria

*** Trenchless Installation** (9Nos. HDD Rigs, 6Nos. Thrust Boring Equipment, 1No. Pipe Pusher and Counting)

- Horizontal Directional Drilling (HDD & CHDD)
- Guided Boring (Thrust Boring)
- Horizontal Boring (Hole hog)
- Pipe Ramming (Casing Installation)
- Micro Tunneling - Slurry Spoil Removal System

*** Flowlines/Pipelines Construction and Maintenance**

- Land/Swamp/Offshore Flowlines/Pipelines Construction, Repairs & Maintenance

*** Production Facilities Construction and Operations**

*** Dredging and Piling Works**

*** Pipeline Security and Monitoring**

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REPLACEMENT OF 10" X 12km UTOROGU – UPS PIPELINE USING HORIZONTAL DIRECTIONAL DRILLING (HDD) IN OML 34



Mobilization of Equipment to Location



Stabilization of drill pad, Perimeter fencing of (50m x 50m) in preparation for site set up



Unloading of equipment and site set up



Positioning of Equipment & Site Set up



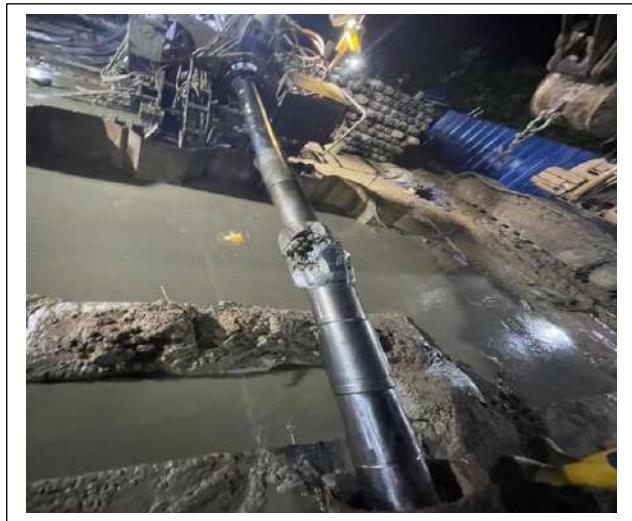
Jetting and to commence Pilot Hole



Pilot Hole Drill



Installation of 16" casing @ Entry Point



Complete Pilot hole by Intersect method



Pilot hole by intersect method



Launch 16/18" reamer



Welding of Pipeline spool



Fit up and welding of PL Spool



Acceptance and dewatering of PL spool



Positioning of PL in preparation for pullback



Set of PL Over bend design



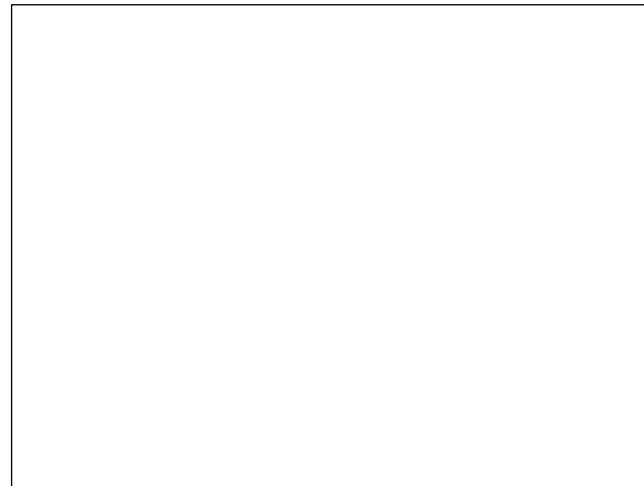
Hook up of Pullback assembly



Pulling of PL Spool



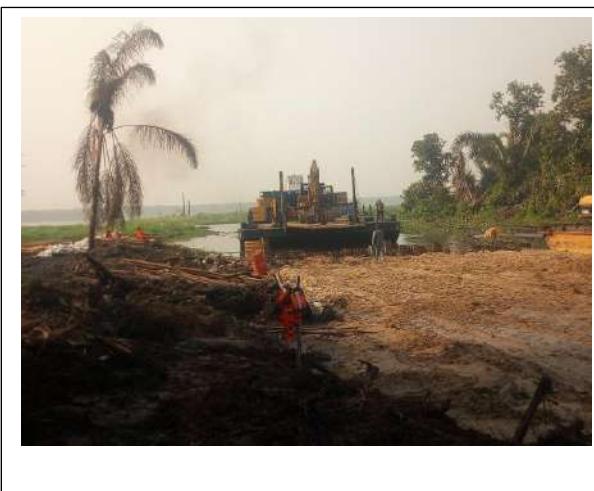
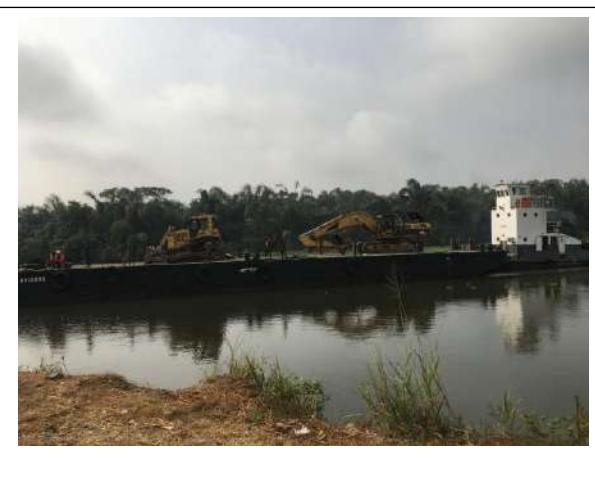
Complete Pullback of Spool



Welding of Tie In joints in cofferdam

FJC of Welded joints

LEKKI GAS PIPELINE PROJECT (LGPP): Installation of 36inch x 1.5km Gas Pipeline Across Swamp and River Using Horizontal Directional Drilling (HDD) Method at Ejirin, Epe, Lagos State.



Mobilization of Equipment by barging

Arial View of Site Set up



Hook up and spud down for Pilot Hole



Installation of Casing



Continue Pilot Hole Drill

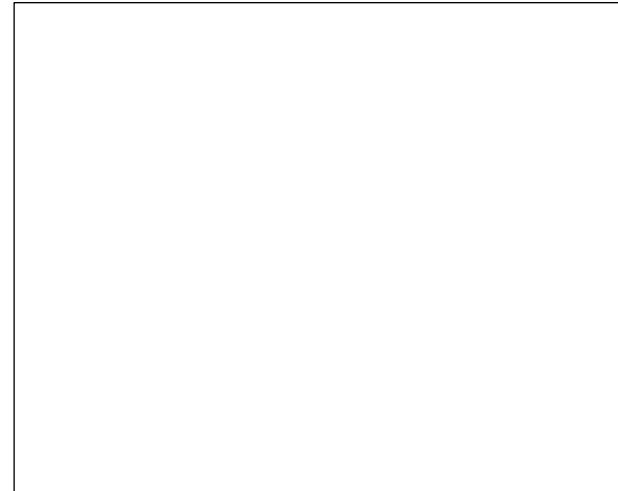


Completed Pilot hole drill and punch out at Rig Side



Commence reaming passes





Mobilization of additional Dredgers 22/24" cutter



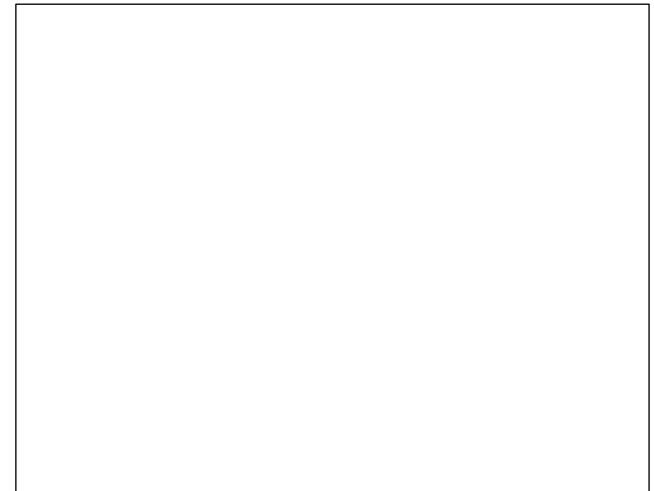
Stripping of Rig Side



Dredging to sandfill Rig Side



Sand filling of Rig Side





Site up of Equipment on barge at Rig Side



Arial View of set up on Rig Side



Welding of Pipeline Spool



Welding of Pipeline Spool



hydrotest of Pipeline Spool



Floating of P/L Spool into ditch



Set up of pipeline overbend



Installation of Pipeline



Installation of cofferdam above area of snapped drill string



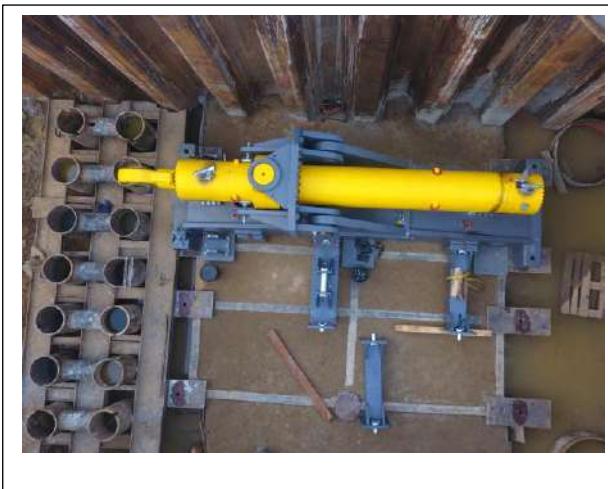
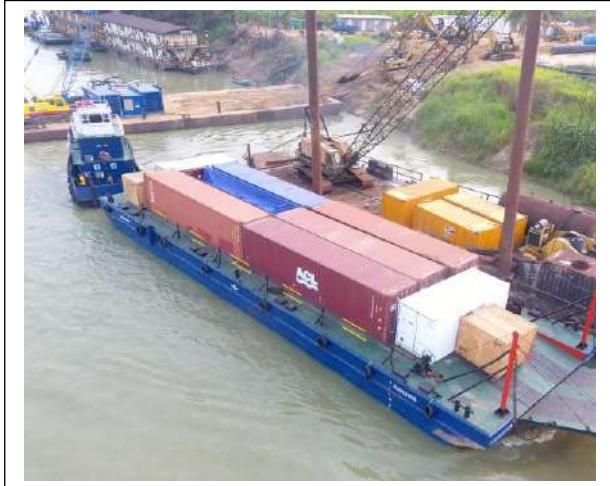


Introduction of divers in to the cofferdam to hook up loose drill string

48" Dia. x 2km Pipeline Crossing by a Combination of HDD and Micro tunneling Across River Niger (OB3)



Micro tunneling Scope

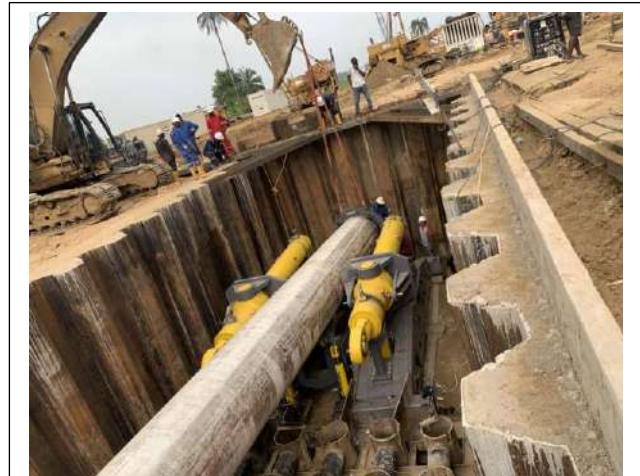
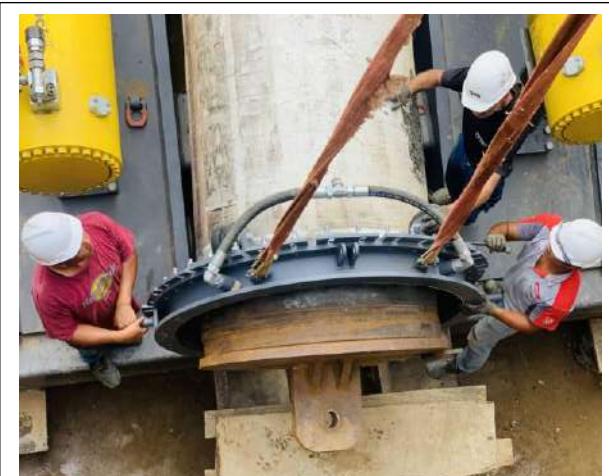




Dummy pipe been positioned to get alignment



Preparation of tunneling assembly for lowering



Position seal and Product Pipe



Alignment of the tunneling assembly inside the pit



Blasting and coating of PL Spool

Welding of Pipeline spool



Set up of mud design



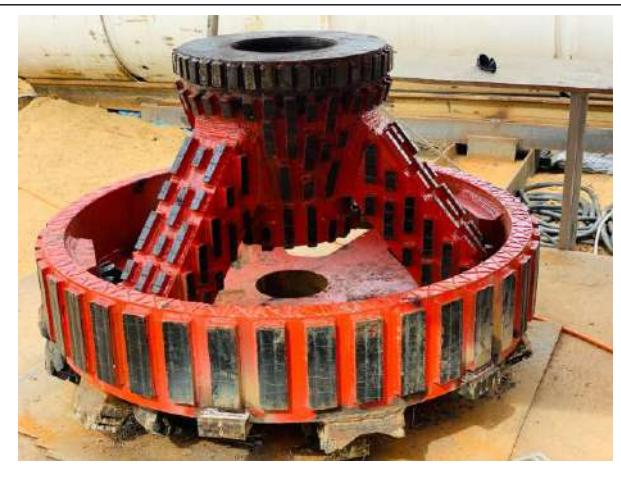
Coupling of pumps and services



Preparation of slider bar



Installtion of Clamps





Modification of TBM



Launch of TBM and commence installation

INSTALLATION of 900m X 12" Steel Pipeline And 900m X 6" Steel casing for FOC Across Orashi River - HDD AND 400m X 12" Steel Pipeline And 400m X 6" Steel Casing Pipe for FOC Across Mbiam - Yenagoa Road and Epie Creek.

SCOPE A (900m X 12" Steel Pipeline And 900m X 6" Steel casing for FOC Across Orashi River)



Mobilization of Equipment



Load out of Equipment into Location



Site Set up and commence Drilling



SCOPE B - HDD AND 400m X 12" Steel Pipeline And 400m X 6" Steel Casing Pipe for FOC Across Mbiamma - Yenagoa Road and Epie Creek



Site Set up



Rig Up



Drilling operations (Reaming Pass)



Completed installation of 6" FOC casing



