



OVERVIEW

Geomechanics was contracted by TOTAL E&P Uganda to conduct geotechnical investigations for the Tilenga project which included a Central Processing Facility (CPF), well pads and a Lake Water Extraction site in Western Uganda; and by TOTAL East African Midstream BV for the investigations for the East African Crude Oil Pipeline to transport crude oil from the CPF to Tanga, 1 443km away, on the coast of Tanzania.



The enormous scale of this project makes it a milestone project for Geomechanics.



THE PROJECTS

Tilenga was a multi-phased project which included the following:

- The nearshore investigations entailed drilling and testing in riverbeds, lake floors and on land. Six rotary core holes and 5 CPTu tests were conducted in the Nile River and another 12 holes and 10 CPTu tests in Lake Albert.
- Land based drilling included 49 rotary core holes and 135 CPTu tests.

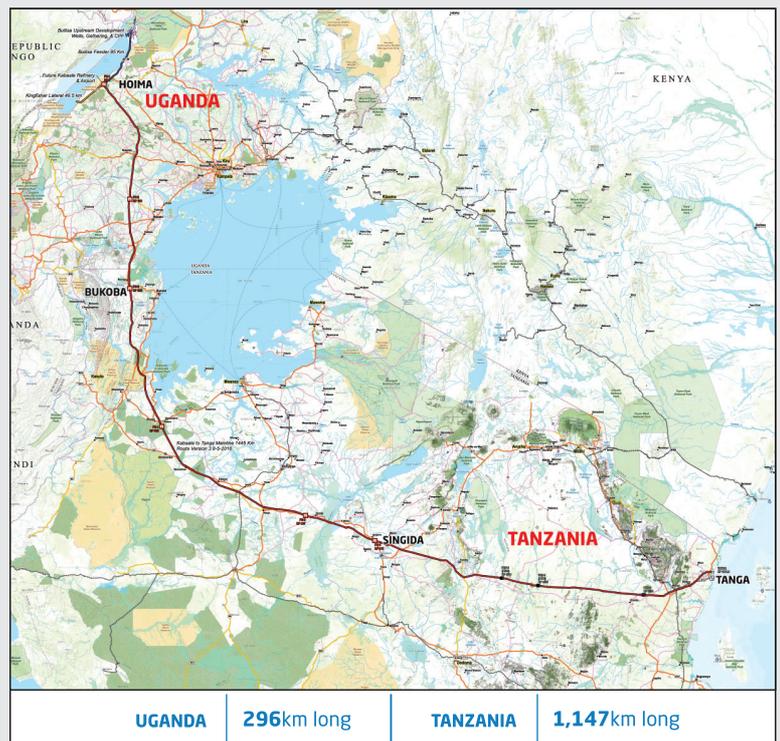
The EACOP pipeline investigations from the CPF to the coast of Tanzania required 21 rotary core holes, 41 CPTu tests and 94 trial pits in Uganda and 37 rotary core holes, 70 CPTu tests and 165 test pits in Tanzania.



THE LOCATION

The Tilenga project is located within TOTAL's Exploration Area 1 (Block 1) on the eastern shore of Lake Albert and Exploration Area 2 (Block 2), covering the districts of Nwoya and Bulisa. The Northern part of the project area is split by Victoria Nile River. The scope of the investigation included the CPF, a pipeline section crossing under the Victoria River, well pads, and the Lake Water Abstraction (LWA) site.

The EACOP project prepared the way for the design and construction of the 1 443km pipeline from the CPF in Kabaale to the Chongoleani peninsula near Tanga Port in Tanzania.



SUCCESS STORY

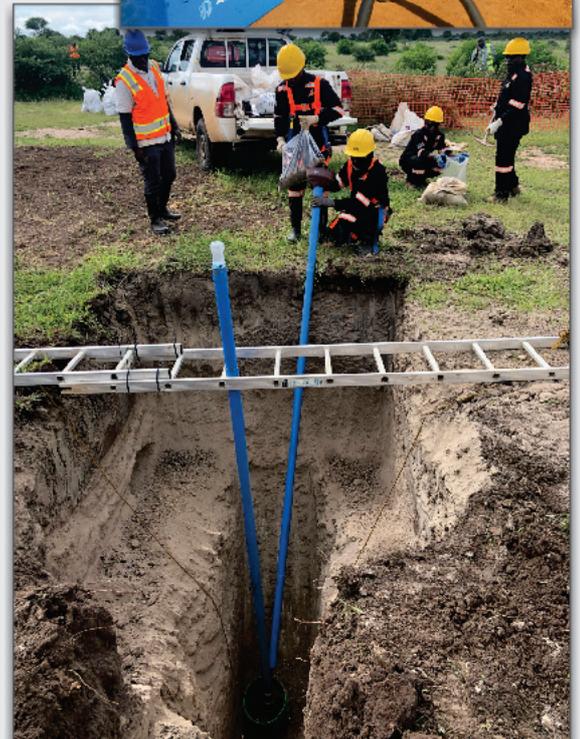
Tilenga and East African Crude Oil Pipeline (EACOP) Project Uganda and Tanzania



THE OBJECTIVE

The objective of the geotechnical investigations was to:

- Characterise the nature of the ground and groundwater
- Confirm lithology and thickness of subsurface layers, based on geophysical surveys previously conducted by Geomechanics
- Provide physical and geomechanical properties of soils required for the CPF, Nile River Pipe crossing, well pads and flow lines, and LWA
- Locate and characterise potential hazards along the planned project route
- Provide recommendations for the future CPF facility's foundations, site preparation, and the Nile River Pipe crossing using horizontal directional drilling techniques.



THE TESTING

The tests completed during the course of these projects indicate the complexity of the investigations. These included:

- Borehole logs, core photographs and drillers' logs
- Standard penetration tests, pocket penetrometer tests, pressure meter tests and cross-hole and downhole geophysics surveys
- Collection of undisturbed Shelby and intact core sub-samples
- Schematic drawings of the piezometer installations
- Cone penetration tests
- Groundwater level readings and in-situ water testing
- Trial pitting and DPL tests
- In-situ tests in trial pits: soil temperature, electrical conductivity, vane shear testing and soil infiltration tests
- As-built survey
- Laboratory testing

Throughout Geomechanics' various investigations all samples taken from boreholes and trial pits were kept in a temperature-controlled environment; beginning with air-conditioned tents on-site, then samples were transferred via refrigerated trucks to a climate regulated laboratory.

Each drill rig and test pitting team had a permanently stationed and qualified geologist.

WORK PACKAGE 1 - The Central Processing Facility

Geomechanics personnel mobilised at Bugungu Camp, some 20 km from the CPF site. Work began with the CPTu rig on the 17th September 2017, followed by five drill rigs in a phased approach from the 18th to the 25th September 2017.

2298.09m of drilling was completed

WORK PACKAGE 2 - The Nile Crossing

The proposed Nile crossing pipeline spans a length of approximately 1.45 km in a north-south orientation, traversing below the Victoria Nile River. An alternative Nile crossing alignment, spanning approximately 1,3km, was later proposed approximately 4 km downstream, with both sites investigated.

Geomechanics's barge and associated equipment arrived on the 11th November 2017 and was then transported to the Nile crossing survey area. Modifications were subsequently made to the barge to meet TOTAL's health and safety requirements. All land based and offshore drilling and CPTs were complete by the 21st April 2018.

WORK PACKAGE 3 - Lake Albert well pads, feeder and flow lines

The Geomechanics' barge was moved to Lake Albert via the Victoria Nile River on the 27th April and commenced with offshore testing two days later.

“We navigated our jack-up barge down the Victoria Nile, at times through 0.8m of water, to reach Lake Albert instead of having to disassemble the barge and transport it, resulting in a roughly three week saving,” Project Manager, Grant Rijismus explains.

The barge was upgraded to suit the site conditions prior to mobilisation. The pontoons were lengthened by 1,8m to increase buoyancy and decrease the vessel's draft. The diameter of the 11,8m long legs was also increased from 168mm to 350mm diameter to meet drilling depths down to 17m.



EAST AFRICAN CRUDE OIL PIPELINE - Tanzania and Uganda

Geomechanic's fieldwork in Tanzania commenced in October 2018 and ended in May 2019. In turn, works in Uganda started in February 2019 and also ended in May 2019

The investigation sites in Tanzania and Uganda were spread across the entire 1 443km pipeline route, crossing a variety of terrain. In general, the investigation sites were selected to be at river and infrastructure crossings, where faults are identified and where the pipeline route has particularly steep slopes. The detailed investigation points were refined on the basis of preliminary results and the preceding geophysical survey.

“Technically, the EACOP investigations were relatively straightforward due to the shallow depth of the boreholes,” says Rijmus. “The key challenge was the linear nature of the investigation and the extensive distances involved.”



THE ENVIRONMENT

Geomechanics always takes responsibility for the environment very seriously. In this case, the sensitive nature of the environment required the use of special environmentally friendly drill muds. Guar Gum (a biodegradable and non-toxic hydrophilic polysaccharide from the seed of the guar plant) and water were used as a drilling fluid medium.

In addition, during the Tilenga Project, all drill muds and used water were safely collected and removed from site. Samples were also tested to prove zero harm to the environment.

During the EACOP project this step was not necessary as the methodology had already been proven environmentally safe.





THE CHALLENGES

SAFETY

The safety standards for this project were very stringent and determined by TOTAL's international regulations.

Geomechanics recorded zero safety incidents during 120, 000 man-hours for the CPF portion of the project.

"Right from preparation phase for the geotechnical surveys contract, which included a number of HSE workshops, Geomechanics always demonstrated a willingness to meet the stringent TOTAL HSE requirements," says Tumwesigye Justus, H3SE/ Safety Operations (2018), TOTAL E&P Uganda

"Even during operations, Geomechanics continued to comply with the TOTAL HSE requirements, as demonstrated by their score of 74% during the Operations HSE Audit for Geotechnical Operations," he continues. *"As a result, Geomechanics was invited to present their 'HSE Journey' at the TOTAL Contractor Forum for the year 2017. In April 2018, Geomechanics won the award for Best Safety Performance 2017 at the TOTAL World Day for Safety awards for contractors."*

LOGISTICS

The linear nature of the pipeline and the long distances between drill positions created substantial logistical issues: more than 400 people needed to be housed in 19 different locations over a period of seven months. At any one time there were three full camps in operation; one for the advance team, one for the acquisition team and another being set up for the advance team to move into. The advance camp moved to a new location every 10-14 days.

WEATHER CONDITIONS

At Lake Albert, where a significant amount of the drilling and testing were conducted from a barge, a combination of inclement weather and high swells caused some downtime on production but all losses were recovered during other phases of the project.





THE GROUP

GeoGroup Companies



GeoGroup comprises of a group of companies, each a leader in its own field, providing a range of services to the geotechnical, civil, mining and energy industries.

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GEO STRUCT

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- Water boreholes
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