

Stantec helps Ethiopia move towards ambitious power goals

Stantec has been helping Ethiopia to develop its hydropower resources for more than 50 years. Power is currently one of the most coveted, yet unreliable resources throughout the country, and the government has set an ambitious goal to nearly double its nationwide electricity capacity by 2025. The recent commissioning of the Genale Dawa III hydropower project is set to increase overall power capacity by almost six percent



Above: The Genale Dawa III Hydropower Project

Right: View of dam downstream face and left abutment from the Bailey Bridge river crossing

Below: Finchaa-Amerti-Neshe (FAN) Multipurpose Project

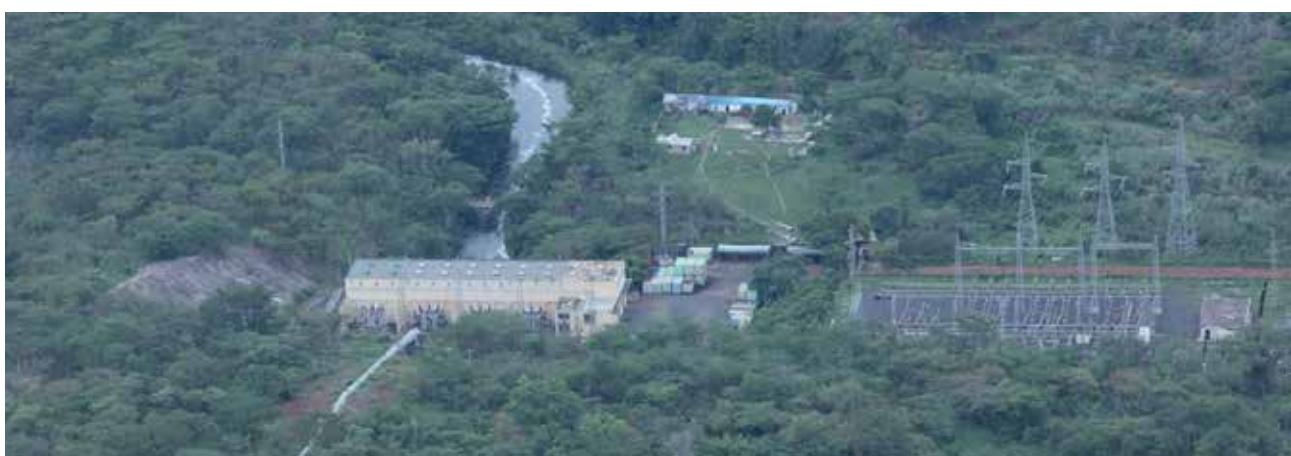
THE GENALE DAWA III (GD-3) hydropower project will soon provide essential renewable energy in Ethiopia. Located in the southern part of the country, it is owned and operated by Ethiopian Electrical Power (EEP).

Ethiopia is committed to accelerating rapid and sustainable growth while increasing access to clean renewable energy. The GD-3 project was initially launched in 2009 to increase the country's electric power demands and to expand irrigation to sustain food security. It will increase the overall power capacity in Ethiopia by nearly 6%, from 4260MW to 4514MW, contributing to the government's ambitious goal of increasing nationwide capacity to 12,000MW by 2025.

Stantec provided contract management consultancy services for the engineering, procurement, and construction (EPC) for the GD-3 project. The company also provided services during the defect's liability period, as well as transfer of knowledge, and training through observation including field activities, mentoring, coaching and classroom workshops with practitioners.

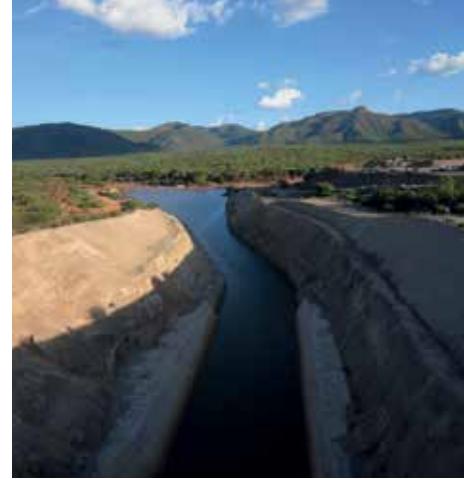
The pre-feasibility and feasibility studies of the GD-3 hydropower scheme were performed by Lahmeyer International (LI) of Bad Vierle, Germany, in association with Yeshi Ber Consult (YBC) of Addis Ababa, Ethiopia, under a contract agreement signed between the consultants and the Ministry of Water Resources from 2003 to 2006.

The cost of the project at tender was US \$451





Above: **Tekeze Hydropower Project**



Above right: **Early stages of reservoir impounding with water entering through the power intake approach channel**

€ million, of which US \$67.8 million was covered by the Government of Ethiopia. The remainder was financed with a loan from the China Export-Import Bank. The completed project is \$650 million.

Technical details

GD-3 tunnel boring machines broke ground to create the headrace tunnel in October 2016. Construction of the dam and spillway was completed in 2018.

The GD-3 hydropower project has an installed capacity of 254MW. Three vertical Francis turbine generators, each with a generating capacity of 84.7MW, are housed in a large underground cavern. The transformers are housed in an adjacent cavern, with power cables extending to an external switchyard via an inclined tunnel.

The CFRD is 110m high with a crest length of 456m; rockfill volume is some 3.22Mm³. The gated spillway comprises an ogee section leading to a 250m long

chute ending in a flip bucket, designed for a maximum discharge of 1880m³/sec. Three radial gates, 5.5m wide by 8.5m high have been installed, to release large floods and maintain a reservoir level at El 1120m asl.

A diversion tunnel handled river flows during construction of the dam; it was 500m long, 9m high by 7m wide, designed to accommodate flows up to 1117m³/sec under a head of 42m.

A 60m high power intake structure was constructed on the left bank of the river, some 600m from the dam, with one large vertical sliding gate and trash racks. It forms the entrance to the headrace tunnel, 8.1m diameter and 12.4km long; 8.9km of this was driven by TBM, the rest was done by traditional drilling and blasting in the very hard granite.

The tunnel leads to a 188m deep concrete lined vertical shaft, 70m of concrete lined horizontal pressure tunnel (6.7m dia.) and 130m steel lined penstock (4.8m dia) and manifold tunnels leading



Stantec in Ethiopia

Stantec has had a long history of working with Ethiopian Electrical Power (EEP) as an owner's engineer, which includes work on the first major CFRD dam in Ethiopia with the main goal of providing clean, reliable, renewable energy for the region. Stantec has a core team of international experts who have worked with EEP on projects such as the Finchaa-Amerti-Neshe (FAN) Multipurpose Project, the Tekeze Hydropower Project, and of course GD-3.

Stantec's experience in Ethiopia dates back to the mid-1960s when it conducted the first studies for the original FAN Power Project in the Oromia Region. The team guided the original project through preliminary and final design, contract tendering, construction, and commissioning, eventually turning the project over for operation by the Ethiopian Electric Light and Power Authority. In the early 1990s, Stantec returned to Ethiopia to expand the original FAN Project. During design and construction of this expansion, it also provided planning and feasibility analysis. The team returned once again to prepare the tender documents for the FAN hydropower development and assisted EEP in the administration of the EPC contract. Since its commissioning, FAN has proved to be the backbone of the Ethiopian power system, providing the most reliable, stable generation source in the country.

In addition, Stantec successfully managed the 300MW Tekeze Hydropower Project. Completed in 2010, it is the tallest dam in Africa. The Stantec team reviewed and prepared designs, prepared construction drawings, packaged and evaluated bids, and managed construction in a remote and mountainous region, increasing energy production in the country by 40%. The Tekeze project also allowed for sustainable social and economic growth for Ethiopians, and the local community infrastructure was greatly improved – including the construction of more than 40km of roads and the first installation of communications links from the area to the outside world. Permanent resident staff members were assigned to the project for key management, technical, and contract administration positions, with technical and project management support coming from offices in the US and Canada.

After successful oversight of the FAN and Tekeze projects, Stantec was selected by EEP for the GD-3 project.

In addition to the field offices at the Tekeze and FAN projects set up during construction, Stantec has maintained a permanent office in Addis Ababa since 2012, focused on the hydropower sector while positioning to engage in key water supply and waste water projects, as well as creating strong ties with the Ministry of Water, Irrigation and Energy of Ethiopia.

Stantec has had the privilege of providing infrastructure, jobs and training for sustained social and economic growth in these communities, such as building a new school and providing the pupils there with learning materials.



Top: Switchyard and central control building

Above and below: **Attendees gather for the inauguration of the GD-3 Hydropower Project on February 4th**

to the powerhouse. Water returns to the river through the 768m long tailrace tunnel (6.7m dia. partially concrete lined) and 480m long open channel - lined with masonry, or concrete where stability was a concern.

Located at the GD-3 main regulated dam, the reservoir inundates about 115km² of land. Out of this, some 70km² is swamp and most of the remaining part is covered by rain forest and bush, which was mostly cleared before reservoir filling.

Impacts

Throughout the project the team faced various challenges. The environmental impacts of the project were studied in depth and were a top priority. Prior to construction 730 households would have to be relocated; 4000 Ha of farmland and 5300 Ha of grassland would be lost. While this was a significant

impact, the project moved forward because of the benefit the Genale Dawa III project would bring to community.

The remote location of the site meant that supply lines for the contractor were long. Getting hydromechanical equipment, such as turbines and generators to site was no easy feat. Some 8300km of sea separates Shanghai, the port of shipment in China, from Djibouti and thence 1300km to site. The remoteness of the site also meant communication was difficult. Poor internet service coupled with zero phone lines was certainly a challenge to the project. Only later during the construction phase was a mobile service set up. There were few medical facilities and the nearest hospital was a six-hour drive away. Travel was also a challenge for the Stantec team and all those involved. Helicopters were not permitted to fly to the project site and flights into nearby towns from other parts of the world could take days.

A major variation to the work was also introduced early on in the project, when it was decided to upgrade the project switchyard and transmission line from 230kV to 400kV. Negotiations over the increased cost of this work continued for several years and caused delays to the progress of the project.

During excavation of the headrace tunnel, various geological conditions were encountered which both prolonged the excavation phase by many months and necessitated the construction of sections of permanent concrete lining that had not been originally intended.

The plant was inaugurated on 4 February 2020. The ceremony was attended by H.E Dr. Abiy Ahmed, Prime Minister of Ethiopia; H.E Dr. Seleshi Bekele, Minister of Water, Irrigation and Energy, and H.E Ato Shimelis Abdisa, Deputy President of Oromia region of Ethiopia, and other honoured government officials. Senior members of EEP, CGGC and Stantec also attended, along with the national TV and the local press.

During the commissioning process, plans to supply the grid were delayed due in part to the Coronavirus, with Chinese technicians being unable to return to site to complete their work. Completion of the whole of the works is expected by the end of June 2020.

The Genale Dawa III project has faced its share of challenges but the end is within sight and it is hoped it will give many years of reliable service, thanks to the efforts of all those who have worked on it over the last decade - not only in the design stage but also in ensuring good quality assurance during construction and installation of the electromechanical works. ●

Author information

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