The Dikgatlhong Dam intake tower and access bridge

# Dikgatlhong Water Project

## FINALIST
### International Projects Category

**KEY PLAYERS**

**Client**
Botswana Department of Water Affairs
**Professional team**
Jeffares & Green, Bergstan Africa and Gauf Joint Venture
**Main contractor**
Sinohydro Corporation of China


The pump station site being prepared

## OVERVIEW

The Dikgatlhong Water Project is a massive project by any standards, with an overall estimated value of some R2.4 billion.

The Dikgatlhong Dam, the raw water transfer system and the associated infrastructure will ultimately deliver an additional 3 000 litres per second of raw water into the existing national north–south carrier pipeline that transports water over 400 km from the Letsibogo Dam near Selebi Phikwe to Botswana's capital, Gaborone.

With a full supply storage capacity of 400 million $m^3$, the dam, which is located 65 km northeast of the town of Selebi Phikwe and a few kilometres below the confluence of the Shashe and Tati Rivers in north-eastern Botswana, is the largest in Botswana, which makes its impact on that country immensely significant.

It was designed and constructed for Botswana's Department of Water Affairs in anticipation of a growing demand for water due to increased mining activities – the major contributor to Botswana's economy – and an expanding population in eastern Botswana.

In joint venture with Bergstan Botswana, and Gauff of Germany, Jeffares & Green's Pietermaritzburg branch undertook the preliminary design review, detailed design, tender documentation and procurement process, contract administration, and the construction supervision of the full project.

Following the two-year detailed design and tendering period, the construction of the Dikgatlhong Dam started in March 2008 and was completed in early 2012.

## EARTHWORKS

The total earthworks volumes for this 4.6 km long by 41 m high zoned earthfill, impervious core, embankment dam were in the order of 3.87 million $m^3$, comprising 550 000 $m^3$ of clay core sourced from local borrow pits and 2.46 million $m^3$ of embankment shell sourced from the excavation of the spillway channels.

As the available core materials proved to be moderately dispersive, close attention was paid to the handling and compaction of the core, as well as the design of the core drainage systems which took into account the results of special laboratory testing of the core and filter materials.

As construction of the embankment took place over several years, and involved two separate river diversion stages, the programming of embankment and spillway construction was critical in order to allow works to continue unaffected by the significant seasonal variations in the river flow.

## SPILLWAY

The main spillway is a 200 m long mass concrete ogee structure with energy dissipaters, situated on the upper left flank about 2 km to the north of the river. There is also a 900 m long auxiliary spillway to accommodate extreme flood conditions and to increase the combined spillway capacity to over 11 000 m$^3$/sec.

## INTAKE TOWER

Other structures include a 7 m diameter by 48 m high concrete intake tower with five gate openings. They feed a 260 m long by 3 m diameter steel outlet conduit passing beneath the dam embankment before bifurcating to a pump station and a river outlet. The intake tower is accessed from the crest of the dam embankment by means of a 61 m long steel bridge.

## PIPELINE

Delivery of raw water from the dam to the junction with the north–south carrier pipeline is via a new 2 MW pumping station, and a 75 km long, 1.2 m diameter welded steel pipeline.

Part of the pipeline route was in close proximity to the existing north–south carrier pipeline, which was constructed using glass-reinforced plastic. This presented a challenge, as blasting was required for trench excavation. Damage to the existing pipeline was prevented by limiting the peak particle velocity to 15 m/s during blasting.

Given that flows and pressure of water entering the north–south carrier needed to be continuously synchronised with those within that existing pipeline, a flow and pressure control chamber was designed which operates in tandem with variable speed flow pumps in the new pump station. This is controlled from the flow control chamber via a fibre optic link along the raw water pipeline. The Dikgatlhong pipeline comprises:

- 44 scour valve installations
- 146 air valve installations
- 4 pigging stations
- 1 feeder tank for transient pressure control purposes
- 1 flow control chamber
- 1 meter chamber
- 3 river crossings

The pipeline is coated with a three-layer PE (3LPE) system. While this involves a marginal increase in coating system cost, the higher level of mechanical and corrosion protection provided by the 3LPE system can significantly reduce the whole-life unit delivery costs. The Department of Water Affairs demanded a high level of protection for this critical pipeline and a technical specification based on the Canadian CSA Z245.21 pipe coating standard was used.

The internal lining consists of a two-component solvent-free polyamine-cured epoxy coating.

The pipes were welded using gas-shielded argon root welding. The pipes were placed in the trenches onto specially manufactured pedestals to allow for welding and coating of the joints.

Material for bedding and cradle fill was sourced from the Shashe and Moutloutse Rivers which required significant haulage. The material also had to be screened before use to prevent any damage to the pipes by oversized material.

Power lines of 66 kV were in close proximity to some sections of the pipeline and required special consideration because of the likelihood of high corrosion risk due to induced currents in the pipeline walls. Specialist surveys were undertaken, and a solution was designed and implemented which comprised the application of alternating current mitigation.

## CONCLUSION

Construction was completed on schedule and within budget. During the last few months the dam water level has reached full supply level. ◻

Preparing for concrete encasement at a river crossing

The pipeline recharge and surge tank under construction