Revival of the Old Lady

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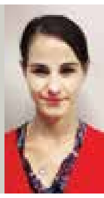

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INTRODUCTION

In 1990, the Old Lady of Grootvlei seemingly exhaled her last breath. As a result of a lack of demand for electricity, Eskom's Grootvlei Power Station in the Province of Mpumalanga was mothballed.

However, as the demand for electricity on the national grid increased dramatically in recent years, although past her prime (she was originally commissioned in 1969), it was decided that the Old Lady of Grootvlei would be upgraded and re-commissioned. The Grootvlei Power Station is the main lifeblood of the area, in that it creates jobs for 3 800 employees, 1 100 of whom are from the local community.

REINSTATING THE RAILWAY LINE

The delivery of fuel is pivotal in the sustainability of any life source, and as part of the mission to revive the Old Lady, Transnet Freight Rail (TFR) Rehabilitation and Construction (R&C) was commissioned to reinstate the Balfour North – Grootvlei railway line, which will be the heartbeat of the power station in that its sole purpose will be the transporting of coal for its survival.

The migration of freight volumes from road to rail transportation is not only a national objective, but a key objective of Transnet's Market Demand Strategy (MDS) and Eskom's road-to-rail migration programme. These common strategies have forged a collaboration between Eskom and Transnet, with the objective of reaching higher targets of freight transportation via rail as opposed to road.

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This transformation could dramatically decrease the volume of heavy vehicles transporting freight on the road networks, thereby reducing the strain and pressure on road infrastructure.

The project consists of two stages – the first stage comprising the reinstatement of the railway line at a cost of R125 million, and the second stage entailing the construction of a containerised coal solution at

Eskom's Grootvlei Power Station

Grootvlei Station. Stage one, during which 21 km of single, non-electrified railway line would reconnect the Natcor mainline to Eskom's Grootvlei Power Station, commenced in January 2013 and was due to be completed by the end of March 2014.

The pre-existing railway line, which was originally designed to accommodate 16 ton/axle loading, consisted of 48 kg/m rails and utilised primarily steel sleepers. Upon inspection, however, it was obvious that this line had been largely vandalised.

The reinstated railway line was designed to accommodate 26 ton/axle loading, which is in line with Transnet's vision of upgrading the country's railway networks to accommodate future increases in tonnage.

The specifications of the reinstated railway line were as follows:

- As the earthworks design of the original railway line had remained intact, the in situ soil could be mixed with the ferricrete present in the soil to form the A-layer of the formation. The construction of the B-layer was not necessary.
- The earthworks design provided for a 200 mm sub-ballast layer and a 200 mm super sub-ballast layer to accommodate 26 ton/axle loading.
- The width of the formation had to be extended from the original 2.4 m to 5.5 m. This requirement necessitated the extension of the existing culverts.
- Reconditioned S60 rails from the OREX line were used in order to reduce the total project cost.
- PY sleepers were spaced at 650 mm to allow for the 26 ton/axle design loading.
- A ballast profile of 1 350 m^3/m (required for 20 ton/axle loading) was adopted as opposed to the standard of 1 600 m^3/m required for 26 ton/axle loading. This was decided upon as a result of the Natcor line not yet having the capacity to support 26 ton/axle loading. Only when the line has been sufficiently upgraded, will the ballast profile of the Balfour – Grootvlei line be increased to support 26 ton/axle train loads.

CHALLENGES ENCOUNTERED

Upgrading the railway line to accommodate 26 ton/axle loading required a portion of the line to be re-graded from the ruling gradient of 1:50 to a gradient of 1:61 as part of the adopted strategy to eradicate severe gradients in order to accommodate longer train lengths without increasing the number of locomotives necessary to haul the train.

The state of the original railway line at the beginning of the project

Re-grading the railway line to a 1:61 gradient with the road-over-rail bridge in the background

The construction of the steel-reinforced concrete deck of the rail-over-road bridge

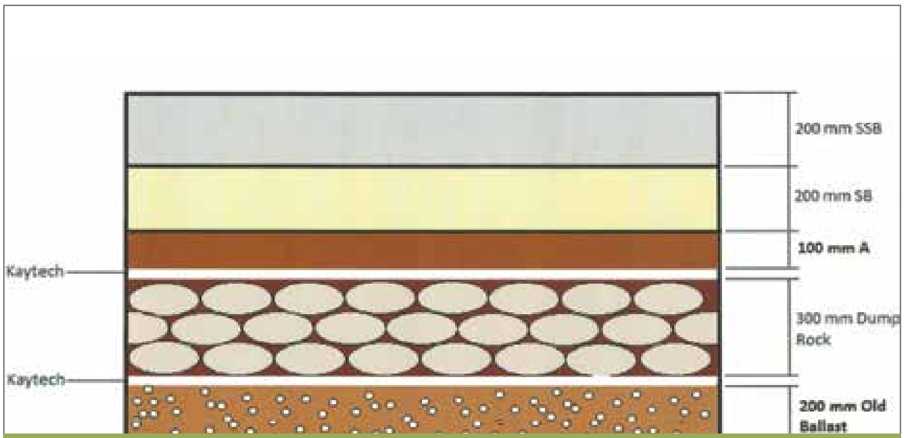
This strategy will decrease the operational costs of the line and will offer the added benefit of decreasing the risk of skid marks.

The earthworks, which were carried out to achieve the gradient of 1:61, resulted in the excavation of in situ soil to the level of the abutment footings of a road-over-rail concrete bridge. This posed the problem of the bridge potentially buckling due to a lack of support. In order to reinforce the structure, steel-reinforced concrete beams were constructed to span the distance from the one footing to the other.

Only once excavations had taken place in the vicinity of the 1.4 km mark, it was discovered that the rail-over-road steel bridge at this point had become too rusted and structurally compromised to adequately support a passing train. Instead of replacing the entire structure of the bridge, it was decided to span the bridge with a steel-reinforced concrete deck which would bypass the steel structure entirely.

Geotechnical samples indicated that a portion of the formation contained clay, known as black turf, which posed a threat to the construction of the railway line due to its swelling properties. It was decided to counteract this problem by using a separation layer method. Dumprock was utilised for this purpose in order to put weight on the clay, thereby supressing the swelling, as well as separating the direct swelling of the clay from the earthworks design layers. This material was selected as it possesses the characteristic of a high weight per unit size ratio.

The initial project completion date was delayed by three months to March 2014. The main reason for this was the delay in delivery of rails as a result of Transnet prioritising the movement of freight trains over construction trains.



The construction method implemented to reduce the effects of swelling clay on the railway line


The nearly completed railway line (photo: courtesy Danie Steenkamp)

FUTURE OF THE PROJECT

Stage 2 of the project is scheduled to commence mid-2014, and the completion date is expected to be at the end of 2014. This stage involves the construction of a containerised coal solution at Grootvlei Station, which will serve as a medium to long-term solution to achieve the interim delivery goal of 3 million tons of coal per annum. It will potentially be ramped up to achieve the ultimate goal of 5 million tons of coal per annum.

This operation will entail gantry crane operations which will offload three trains, consisting of 45 wagons each, every day. The coal will be offloaded directly into coal trucks via bottom-discharge containers for a short road haul of approximately 2 km to the Grootvlei stock yard. The empty containers will immediately be returned to the train to be transported back to the coal fields.

This option has the following benefits:

- Operations will be optimised as a result of faster loading and offloading times due to the use of bottom-discharge containers. The contents of the wagons can be offloaded in a time span of one minute.
- The use of bottom-discharge containers will reduce the risk of product degradation.
- Safer and more environmentally sustainable offloading processes will be ensured as a result of the use of bottom-discharge containers.
- Similar operations have been successfully used in the past in operations in Swaziland and Saldanha.
- Transnet possesses the resources and competence to manufacture the bottom-discharge containers.
- Train turn-around times will be reduced, resulting in improved utilisation of assets.
- The number of containers required for the operation will be optimised due to the elimination of container stacking.
- Additional capacity will be generated as a result of the optimisation of operations.

CONCLUSION

The project was kick-started and followed through by the Senior Contracts Manager, Callie Herselman, of TFR R&C. R&C was responsible for the construction of the track and civil works surrounding the trackwork. The design consultant for the project is RCE, who is responsible for the design and quality control of the earthworks and trackwork, as well as the design of the steel-reinforced concrete deck. As an Engineer-in-Training of TFR R&C, I am fortunate to be involved in the project as I am being exposed to both fundamental and complex engineering elements and construction processes, which will contribute greatly to my experience and training programme at the company. ☐