

Ingula

mega project taking shape

In the Little Drakensberg, just outside Ladysmith in KwaZulu-Natal, the Ingula Pumped Storage Scheme (IPSS) is under construction for power utility Eskom – 116 storeys underground! Under the supervision of Royal HaskoningDHV (formerly SSI Engineers & Environmental Consultants in joint venture) construction is progressing on this R30 billion project which will increase South Africa's energy generating capacity during peak demand periods

IPSS HAS SEEN the formation of several joint ventures, including the Braamhoek Consultants Joint Venture (BCJV) comprising three of the country's major consulting firms, namely SSI, Arcus Gibb and Knight Piésold, who have been involved with project design and construction supervision since inception.

The BCJV appointment included the project's tender design, construction design, and the construction supervision of four contracts within the bigger project, namely the dams' contract, the main underground works, turbines and generators, and various surface buildings.

The IPSS consists of the upper Bedford Dam and the lower Bramhoek Dam, each with a capacity of approximately 26 million m³ of water. The dams, which



Completed 49 m high Bedford Dam (concrete-faced rockfill)



Bedford Dam under construction

are located 4.6 km apart, are connected by underground waterways through a power house complex which will house 4 x 333 MW Francis-type turbines with a total generating capacity of 1 332 MW. During times of peak energy consumption water will be released from the upper dam through the turbines to the lower dam in order to generate electricity. When the energy demand is lower than the base load supply, the pump turbines drive water 441 m from the lower to the upper dam where it is then stored in readiness for the next peak event.

Construction of the Bedford and Bramhoek Dams commenced in April 2008 and was completed by August 2011. The design of the Bedford Dam, being situated inside a wetland, incorporated a number of environmental mitigating measures of which wetland protection, landscape aesthetics and artificial bird cliffs are but a few. Another interesting fact was the discovery of approximately 255-million year old animal and plant fossils during dam excavation works.

The Bedford Dam is a 49 m high concrete-faced rockfill dam with a crest length of 810 m. Its complex design has won a number of awards for the BCJV – the 2011 CESA AON Engineering Excellence Award, the 2011 *Construction World Best Projects* award, and most recently, the 2012 SAICE Outstanding Civil Engineering Achievement award for the best project identified by the SAICE Water Engineering Division.

Construction of the underground power house complex and access/link tunnels was started in September 2008 and is currently entering a new phase with the completion of the excavation and rock support activities, and commencement of civil works together with the installation of turbines and other mechanical items.

The nature of the geological conditions encountered underground presented the designers and contractors with some unique challenges, as the power house complex is the largest yet constructed in mudrock, making environmental and safety issues of paramount importance.

The use of a three-phase rock support system and extensive instrumentation made possible the construction of the power house cavern. The excavation of the very steep headrace tunnels (45.5°) involved specialised equipment and techniques by the contractor, and close cooperation among all parties. The deep excavation in soft ground, required for the fresh air intake shaft, was successfully completed in a relatively short time by micro-piling the first 24 m.

Ultimately five contractors (civil, mechanical, cranes, transformers and electrical/earthing) will be working inside the power house simultaneously, which will necessitate very close cooperation to maintain project momentum.

The first of the four generating units is scheduled to come online during 2014.



Access tunnel excavations at the Ingula Pumped Storage Scheme



First draught tube installation at Ingula

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INGULA FACT BOX

- Energy storage: 21 000 MWh (15.8 generating hours)
- One of the biggest construction projects currently in South Africa
- The machine hall at 180 m long x 25 m wide and 40 m high is the largest excavation cavern in mudrock in the world
- Nine kilometres of tunnels
- The power station is 116 storeys underground
- Three million cubic metres of rock excavated
- A dolerite quarry produced 2.4 million tons of aggregate
- Imported from Germany: 15 000 tons of steel lining for the waterways