Murray & Roberts Cementation is close to completing the construction of a cemented full plant tailings (FPT) backfill plant at Gold Fields’ South Deep Gold Mine near Westonaria. The commissioning of phase one of the new plant— the largest of its kind in South Africa — will represent the third type of backfilling implemented at the mine over a period of 18 years.

The new FPT plant has already attracted a lot of international interest. Rob Bradley, manager mine engineering at Murray & Roberts Cementation, says the application of backfilling has passed through three stages owing to the various mining methods which have been used during the development of the mine to date. These advanced mining methods have required the adaption of the backfill type and system to keep pace with production levels and geological structures. The three stages comprise the backfilling of the new twin shaft pillar area, followed by cyclone classified tailings backfill (hydraulic fill) for the narrow tabular stopes, as well as some larger stopes, and finally, de-stress and longhole mining backfill to suit present day requirements.

“Each change was preceded by significant feasibility studies and test work to mitigate all safety risks and ensure a robust and cost-effective solution,” Bradley
says. “A depth of 3 200 metres below surface, as well as the size of the orebody, has made the South Deep backfill project one of the most challenging and exciting undertakings we have ever been involved in.”

Backfill operations began in 1993 with the sinking of the 2 988 metre twin shafts at South Deep Mine, formerly known as the Western Areas Gold Mining Company South Shaft. The location of the shafts required the main shaft pillar to be mined out and backfilled at a depth of 2 500 metres below collar. This called for a high strength backfill appropriate for the narrow tabular stopes around the shaft pillar and it was decided to use a crushed waste/cyclone classified tailings (CW/CCT) backfill.

After the shaft pillar had been backfilled, the cost of the high strength CW/CCT backfill proved too high to be sustained for the rest of the mine and, following test work and modeling, it was agreed that a cyclone classified tailings (CCT) hydraulic backfill would be more suitable.

Later, as the mine intensified massive mining (stoping between 2 metres and 15 metres in height) Murray & Roberts Cementation, in conjunction with the mine, devised an interim solution whereby the backfill flow rate and strength was increased to cater for the larger stopping areas. Further enhancement became
necessary when additional massive mining long-hole stopes and increased production was planned, requiring additional backfill.

As the maximum cyclone underflow recovery for CCT is 40%, it became clear that the backfill quantity being manufactured would be insufficient to cater for the expected average gold tailings output of 520 tph, at a production rate of 330 ktpm. Murray & Roberts Cementation conducted a feasibility study to investigate alternative backfill options, taking into account the volume of backfill, depth of mining operation and the geographical location of the mining areas. Based on rheological and other test work, it was decided that an FPT backfill plant would best suit the mining operation, providing a smaller footprint than the previous system and presenting the mine with a cost effective backfill production methodology.

With Phase 1 scheduled for completion by November 2011, the entire FPT system — designed and engineered by Murray & Roberts Cementation — is expected to be fully functional by July 2012.

“The primary purpose of backfill at South Deep today is to provide regional support for mined out areas up to 30 metres, to maximise ore extraction and reduce the underground ventilation and refrigeration requirements. Surface environmental pollution is mitigated by the transfer of tailings underground,” Bradley says.
“The design of the FPT plant makes provision for all gold plant tailings to be supplied to the new backfill plant for FPT backfill manufacturing, with a provision for excess tailings to be transferred back to the gold plant for disposal on the tailings dam, should the backfill plant be unavailable. The backfill plant will require a constant supply of gold tailings at a rate of 420 tph, with relative density of 1.4 to manufacture 148 000 m³ FPT backfill every month.”

Tailings will be transferred from the gold plant to be temporarily stored in four storage tanks, previously used in the gold leaching process, and will either be pumped back to the gold plant or to the backfill plant, depending on the backfill requirement.

The backfill plant will be equipped with flushing facilities to prevent binder, tailings and backfill lines from being blocked. Flushing water for the plant will report to the backfill plant sump before it is pumped back to the gold plant. A standby generator will provide power for essential operations to continue in the event of a power failure, but will not operate the entire plant.

Bradley says a total of 24 pipes have been allowed for the final reticulation. Nominally, only 12 pipes would be required to supply the quantity of backfill, but owing to the vast geographical area and the mining sequence, it was necessary to spread the backfill reticulation over large areas.
Murray & Roberts Cementation has been involved in backfilling projects since 1981 and today is the most active company in this field in South Africa, as well as the only local company able to provide a full-spectrum backfilling solution, from feasibility to management of rheology, design, construction, commissioning and plant operation.