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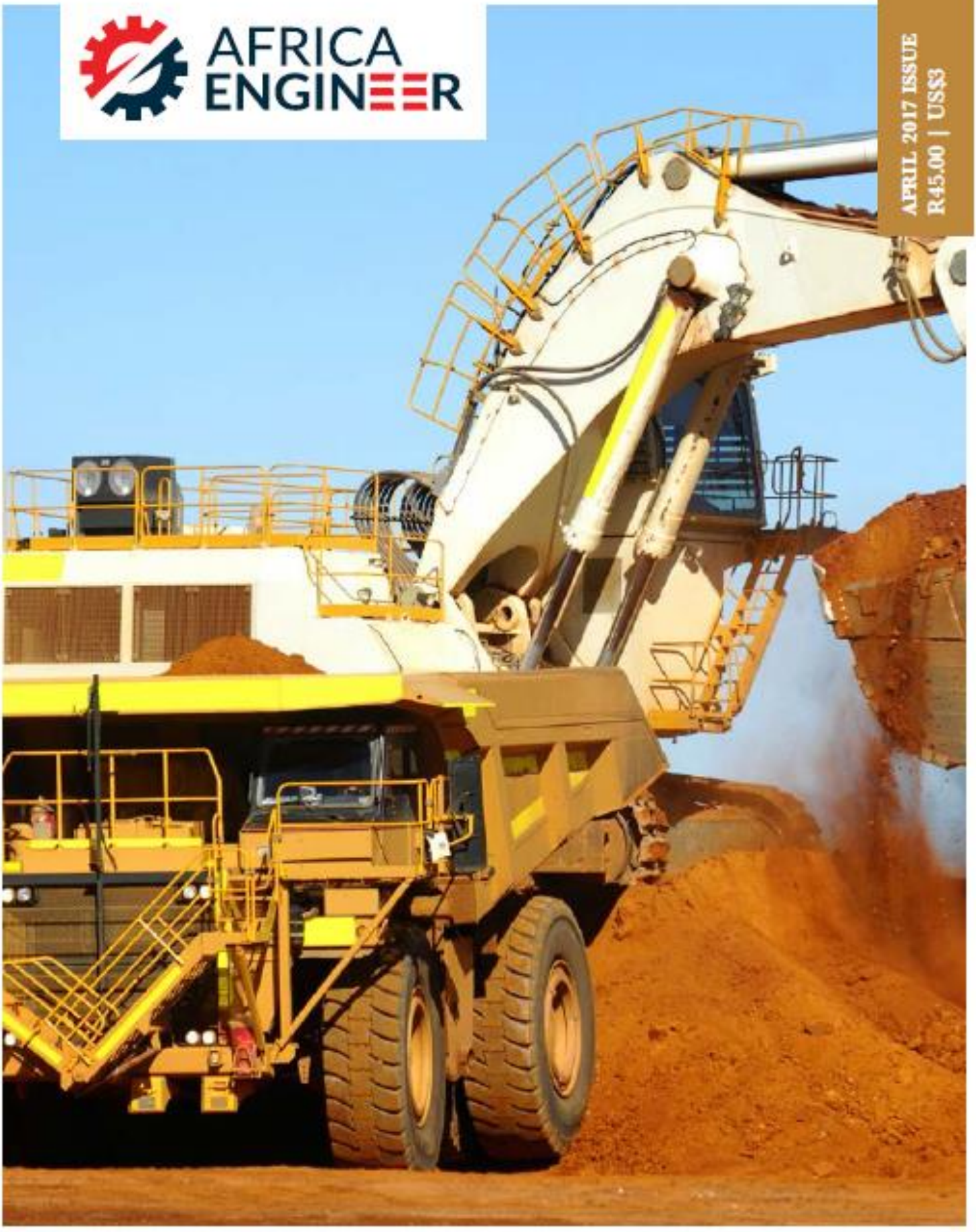

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Waste gas fix at South Africa's flagship plants

South Africa's Medupi and Kusile power plants will utilize induced air fans to balance pressure losses in the flue gas channels between the boiler and chimney.

Aging infrastructure and lack of new constructions have led to a steady reduction in reserve capacity in the South African electrical power grid, which has led to forced shutdowns of mining operations and unexpected power outages.

To counter these developments, state-owned Eskom has unveiled an extensive construction programme that will allow it to produce more electricity.

With a total capacity of 17,384 MW, the planned developments not only include a pumped-storage power plant, wind farms, a solar power plant and improvements to infrastructure, but also large coal-fired power plants at the Medupi and Kusile sites.

The Medupi complex unit 1-6 alone, in Lephalale on the Botswana border, comprises six blocks each with a total output of 880 MW. Upon completion, this will be the fourth largest power plant in the world.

Kusile 1-6 also produces 880 MW per block and is located in Johannesburg's Mpumalanga province. To ensure that waste gases are discharged from the boilers into the atmosphere, 12 induced air fans with a drive capacity of 9500 KW and a revolution speed of 745 rpm have been installed at each of the sites. The contract was awarded to the German company TLT-Turbo GmbH.

Ventilators are a fundamental part of the combustion process in any power plant. Fresh air ventilators draw the required air into the coal burners, primary ventilators dry the coal dust from the mills and transport it to the coal dust burners, and induced air ventilators draw the waste gases from the boiler through the flue gas channels and filters to the chimney.

The latter are incorporated in the boiler protection measures and are controlled depending on the operating point and boiler pressure, so that the waste gases are sucked in and no inadmissible negative pressure or excess pressure is created in the boiler. If this is not ensured, it is possible that the boiler or flue gas channels can leak, releasing pollutants into the air, which would pose a danger to both employees and the environment as a whole.

Adjustable blades

Both the Medupi and Kusile sites will be equipped with two induced air fans per block, each with a capacity of 50 per cent of the maximal power plant output. Such fans are usually used in large industrial furnaces where the stack effect alone does not provide sufficient suction.

In the case of the power plant blocks in South Africa, pressure losses in the flue gas channels between the boiler and chimney are also caused by flue gas purification (REA), air heaters (LUVO), filters and other components.

"The induced air fans balance the losses by creating a volume flow of 738 m³/s to raise the pressure to 61 mbar, thus ensuring smooth operation", says TLT's Bernd Schmidt, who works as general project manager in South Africa and is responsible for everything from managing the contract to ensuring customer approval of the completed project.

If an inadmissible drop or increase in pressure should occur, the induced air fans are automatically switched off and the power plant is shut down by the control system. The induced air fans are equipped with a two-tier rotor to achieve the best possible pressure levels and optimal operation. The rotor blades have an outer diameter of 4 m and the hub a diameter of 2.33 m. The induced air fan has a maximum height of 5.34 m and a length of just less than 11.3 m. The total weight is 136 tonnes, although the rotor alone weighs in at 18 tonnes. The fan is driven by a 41 t, 9500 MW engine that operates at a constant speed of 745 rpm.

The output is regulated by hydraulic blade adjusters that adapt to meet the changing requirements. This mechanism is connected to an oil supply system that is controlled via the central power plant control system according to current boiler performance. This ensures an efficiency of up to 88 per cent.

The process-related aspects of the design were specified by Eskom, which produces approximately 95 per cent of South Africa's electricity and 45 per cent of all electricity used in Africa.

"Ten operating points were specified for the engine characteristics of the induced air fan; it is important that these points can be reached reliably without compromising on the high level of efficiency," explains Schmidt. "In terms of the construction it was also necessary to ensure that the operation of the induced air fans required as little energy as possible. The annual availability must be at least 98 per cent, meaning that only very short downtimes and maintenance periods are permissible."
The various projects are currently in different phases of construction. While block 6 at the Medupi site has been producing electricity since August 2015, the remaining blocks are expected to be connected to the network gradually over the next few years, depending on construction progress.

Careful project management

TLT's site planners laid the cornerstone for receiving the contract during the bidding phase from 2006 to 2008. An intensive pre-qualification phase in the form of a preliminary design for the site plan and the presentation of this to the operators ultimately led to the contract being awarded to TLT. A design review was then carried out and checks were made to ensure that the induced air fans meet consumer specifications, including requirements for acoustic thresholds. The necessary permits for the production - including the main subcontractors - also needed to correspond with the customer's and operator's specific criteria in terms of quality control and quality assurance.
Because of the large order volume, the tight schedule and the pressure to keep costs as low as possible in order to beat local competition, this contract was a challenge that required a number of special measures.

From the first tender onwards, it was necessary to implement intense project management that incorporated a clearly defined schedule and monitoring procedures. The strength of both the European and non-European markets was taken into consideration when purchasing the necessary materials and steps were taken to ensure that a balance was found between the two.
Essential functional components were produced at TLT's own site in Germany and assembled to form component groups. The function of the rotors and oil supply systems was also tested. The large stator components were produced and assembled for testing and measuring outside of Europe; however, they were then dismantled for transportation and shipped directly. In this way 40 lorry-loads per block were shipped to South Africa.
"It took a number of years to complete the design, production and

assembly. Unrecognized defects or shortcomings in the project can cause significant financial problems for the company and are also difficult and expensive to rectify in South Africa," says Schmidt.
"Every induced air fan is a tailor-made product specifically designed for its particular purpose and thus unique in terms of its characteristics. The relevant monitoring points are tested based on the corresponding plans both during production and before shipping. The results are documented to avoid serious irregularities.

"Furthermore, any possible problems that may be encountered by the relatively inexperienced local companies when assembling the small-batch components from different production sites also need to be taken into consideration. For this reason, the individual elements were assembled into functional machines using TLT assembly instructions and inspection plans."
The fitting measurements between the rotors and the stator of the heavy components have an extremely narrow tolerance and require careful assembly.
The rotating and stationary components of the induced air fans are 'married' at the construction site, and it is at this point that it becomes clear whether the supply chain has been properly managed at all stages of the process.
To ensure that everything ran smoothly, the plant manufacturers commissioned a technical supervisor from TLT who advised those building and assembling the power plant during the construction phase and checked that the assembly work was carried out correctly. To avoid unnecessary downtime, the entire induced air fan was connected to the power plant control system and tested once more by TLT startup engineers and then approved for operation.
Initial commissioning demonstrated a good performance and interference-free operation in accordance with the power plant's requirements.