

**ENGINEERING A NOVEL AUTOMATED PUMP
CONTROL SYSTEM FOR THE MINING
ENVIRONMENT**

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Abstract

South Africa is experiencing serious electricity supply problems. A major concern is the high peak electricity demands between 18:00 and 20:00. This peak is primarily caused by the growing residential sector. Unfortunately, changing people's behaviour to reduce the evening energy peak is difficult. An easier approach will be to focus on other sectors such as the industrial and mining sectors.

South African mines contribute 18% of the country's electricity consumption. Of the total mining electricity bill 40% is consumed by water pumping systems. Manual load shifting is attempted on approximately 15% of these pumping systems. The results are not sustainable due to maintenance problems and system complexities.

By automating, simulating, optimising and controlling the pumping systems of deep level mines, sustainable load shift can be achieved. This will also reduce the running cost of mine water pumping system due to time based electricity pricing.

With this research a novel solution is presented. This unique automated tool simulates, optimises, schedules and controls any pumping configuration in a unique integrated fashion. The new system was tested in 13 case studies, involving a wide variety in terms of layout, size, and equipment types. More than 39 MW of load was consistently shifted out of the evening peak. This resulted in cost savings of more than R 5,7 million per year for the mines involved in the case studies.

This system also has other benefits. Automated systems require fewer personnel such as pump attendants, leading to more savings. The system also provides better safeguard against the risk of flooding, and faster training of new control room personnel. The benefits for ESCOs are fast and accurate predictions on the savings potential of specific pump configurations.

These and other benefits indicate that the new control system should be rolled out on all large pumping systems.

Opsomming

Diep myne in Suid-Afrika dra 18% by tot die nasionale energieverbruik. 'n Studie in 'n tipiese diep myn toon dat die piek aanvraag tot 27% gesny kan word met die gebruik van 'n geoptimeerde energiebeheerstelsel. Dit kan lei tot 'n potensiële jaarlikse besparing van R 135 miljoen in die Suid-Afrikaanse mynbedryf.

Tydgebaseerde elektrisiteitstariewe maak hierdie elektriese kostebesparings moontlik. Die energielas word daaglik verskuif van hoëkoste na laekoste tye. Deur hierdie beginsel toe te pas kan die hoogste kostebesparing op mynwaterpompstelsels gegeneer word.

'n Literatuurstudie en gesprekke met mynbeamptes het aangedui dat daar nog nie 'n stelsel op 'n Suid-Afrikaanse myn geïnstalleer is om die potensiële kostebesparings te benut nie. Die rede hiervoor is 'n gebrek aan geoutomatiseerde pompbeheerstelsels en die moeilikheidsgraad van geoptimeerde beheer.

Hierdie tesis bied die ontwikkeling van 'n nuwe oplossing aan. Dit is 'n unieke geoutomatiseerde stelsel wat simuleer, optimeer, skeduleer en beheer. Hierdie stelsel is ontwikkel om enige industriële pompstelsel te beheer. Die stelsel is op 13 myne in verskillende omstandighede getoets. Meer as 39 MW las is volhoubaar uit die aandpiek geskuif met 'n volhoubare kostebesparing van R 5,7 miljoen per jaar.

Die stelsel het ook ander voordele. As gevolg van die outomatiese beheer benodig myne minder operateurs wat tot verdere besparings lei. Die stelsel kan ook aangewend word om myn personeel vinniger op te lei. Die voordeel vir ESCOs is vinnige, akkurate projekpotensiaalvoorspellings.

Hierdie en verdere voordele van die nuwe stelsel wys dat die installering van hierdie nuwe oplossing op alle groot mynpompstelsels voordelig sal wees.

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Nico de Kock drove the implementation of REMS for my case studies. He helped with the performance calculations and reports of the case studies.

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Nomenclature

C/kWh	Cent per kilowatt-hour
CO ₂	Carbon Dioxide
DDE	Dynamic Data Exchange
DSM	Demand Side Management
EE	Energy Efficiency
ESCO	Energy Services Company
GUI	Graphical User Interface
GW	Gigawatt
GWh	Gigawatt-hour
HVAC	Heating Ventilation and Air-Conditioning
MW	Megawatt
NER	National Energy Regulator
OLE	Object Linking and Embedding
OPC	OLE for Process Control
PBMR	Pebble Bed Modular Reactor
PLC	Programmable Logic Controller
RTP	Real Time Pricing
REMS	Remote Energy Management System
SA	South Africa
SCADA	Supervisory Control and Data Acquisition
SMS	Short Message Service
SO ₂	Sulphur Dioxide
UK	United Kingdom
USA	United States of America
WEP	Wholesale Electricity Pricing

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