

INNOVATIVE VOLTAGE REGULATION SYSTEM HANDLES COAL

It was possible to pre-determine how the regulation system would behave in response to dynamic loading including surges, and fault conditions.

Newcastle has a long history of coal exporting starting in 1799 when "The Hunter" carried the first coal from the port to Bengal via Sydney. Two hundred years later Port Waratah Coal Services Limited (PWCS) commenced stage 3 expansion of their Kooragang facilities extending capacity to 89 million tonnes per annum. They are now the largest and most efficient coal handling operation in the world.

Continuous 24 hour a day operation of the two million tonne stockpile via rail unloaders, stackers, reclaimers conveyors and shiploaders requires a substantial investment in reliable power. When stage 3 was undertaken a further three 10MVA 33/6.6kV on-load tapchanging transformers were installed to augment three similar units which had been in service for 20 years.

RELAYS UPGRADE

Following a review of available voltage regulating relays the local engineering consultants chose the a-eberle REGSys™ system for the new transformers. Subsequently a further three relays were purchased to upgrade the original units. The voltage regulators were supplied by Protection and Monitoring Systems, who are also based in Newcastle. A significant factor in this choice was the ability to simulate the voltage regulation environment prior to installation and commissioning via REGSim™ software. It was thus possible to pre-determine how the regulation system would behave in response to dynamic loading including surges, fault conditions, etc. and therefore maximise system reliability before going on-line.

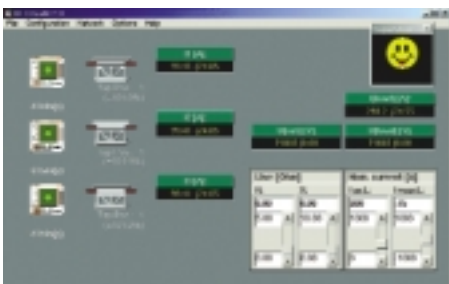


Figure 1: REGSim simulation software

The REGSys VRRs are very easy to set up for parallel operation using the in-built ParaGramer software. This displays the transformer network and associated switchgear and bus system. On the basis of the switching states the system automatically recognises which transformers are on a common bus and initiates raise or lower signals to the appropriate tapchangers to maintain parallel operation and keep circulating currents to a minimum.

Several modes of paralleling are available including master/follower, master/slave, or circulating current methods in which the relays communicate with each other across a fibre-optic



E-LAN RS 485 interface. The initial design brief required any of the six transformers to be operated in parallel to a maximum of four at any one time. This meant transformer A1 could be in parallel with transformer C3 in another substation up to 3 kilometres away. Additionally, transformers can be switched in and out at any time and under varying load conditions. Thus a very flexible scheme was important.

Because PWCS have more than one 6.6kV bus and transformers spread across several km of site they normally operate in what is known as Δ Isin ϕ mode in which each transformer is maintained in parallel with minimum circulating current. In the event of an E-LAN failure the system reverts to the Δ cos ϕ (emergency) mode in which all tapchangers are independently controlled by their associated VRR to maintain close as possible to the network power factor immediately before the communications link was interrupted.

All methods of parallel operation (except Δ cos ϕ) use the E-LAN for the exchange of data. As the Δ cos ϕ - method operates without ELAN bus connection it is ideal for this emergency role.

Additional digital inputs were programmed using the regulators inbuilt programming language which allows for standard logical expressions to be used, giving greater flexibility in system design.

A sample line of code that adds a custom menu to the regulator's display for calibration of an analogue current input is shown here.

```
H 2='menuappn 2="Trans.Cali",menuapp 2=102'  
H 3='menuappn 6="offset",menuapp 6=106'  
H 4='menuappn 7="dl step",menuapp 7=107'
```

Another of the many benefits of the REGSYS is the ability to set and adjust any of the regulators from one location due to the flexibility of the WINREG™ setting software. Changes can be implemented and observed in real time, with the operation of all regulators being viewed on the one PC screen

The a.Eberle REGSys™ voltage regulating relays have enabled PWCS to maintain close voltage control on the 6.6kV system which is essential for reliable operation of numerous drives and control systems. Because the system allows fine tuning of both voltage and circulating current the overall number of tapchanges has reduced which will also have a positive impact on the maintenance budget.

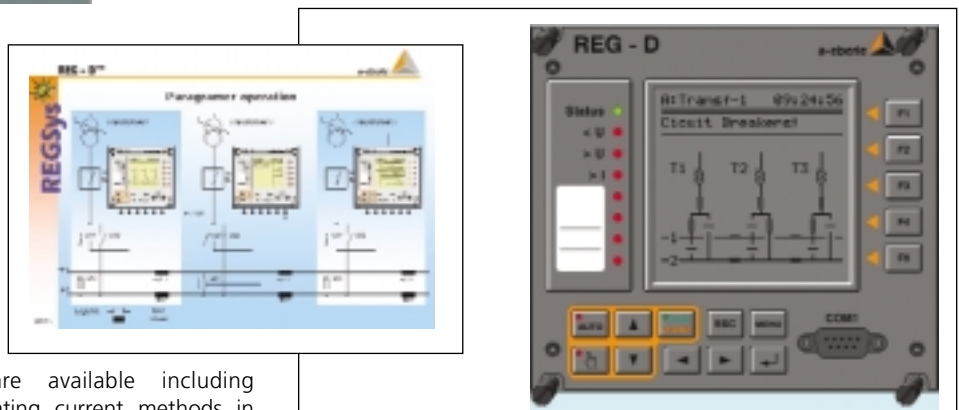


Figure 2: ParaGramer display