

VOLTAGE REGULATOR RELAY

application

Transformers with different MVA ratings and impedances have been successfully parallel connected for flexible operation under a range of conditions.

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Happy Valley and Morphett Vale East (MVE) 275/66kV substations are located only 10km apart in the midst of Adelaide's southern suburbs, a rapidly developing residential and commercial area. They are key installations in ElectraNet's bulk supply of the region together sharing a demand of some 500MW.

DIFFERING TRANSFORMER SIZES

Optimum load sharing between the substations has been difficult due to differing transformer sizes and impedances and close interconnection via a number of 66kV lines. Application of the REGSYS voltage regulator system, manufactured by a-eberle GMBH of Nuremberg in Germany has provided a unique and flexible solution allowing the two substations' Automatic Voltage Regulator Relay (AVR) systems to be operated in automatic mode and in parallel with reduced circulating currents. Optimising the secondary system in this way has improved primary asset utilisation.

SYSTEMS OPERATED MANUALLY

Historically MVE substation's two 225MW 275/66kV identical transformers have been operated in parallel with tap changers in bank control. At nearby Happy Valley, the three non-identical 180MW units were operated similarly, however due to differing impedances, circulating currents at this substation were always a problem. Furthermore the substations were interfering with one another over the 66kV interconnections because adjustment of the taps on one transformer would affect the other four. ElectraNet engineers were also faced with the problem of the inefficient flow of MVARs between MVE and Happy Valley, which they could observe by means of the SCADA system, but not successfully control. As a result both systems were operated manually requiring system control personnel resources to perform tap adjustments at least twice daily.

VOLTAGE REGULATOR SYSTEM

Following a review of available AVR relays, ElectraNet engineers selected the a-eberle REGSYS voltage regulator system for this application due to its unique capabilities. One REGSYS AVR relay has been installed for each of the five transformers, and these communicate with each other across a proprietary a-eberle E-LAN RS 485 serial interface. A radio link joins the Happy Valley AVR's to the MVE AVR's, one of the first of its type in the world. This voltage regulating system, through circuit breaker status inputs determines whether transformer operation should be independent or parallel and performs this automatically. This arrangement minimises MVAR flows between the substations and optimises voltage at the 66kV buses. It monitors 66kV voltage and current and adjusts for changes in load, power factor and 275kV voltage.

ONE TRANSFORMER AT A TIME

The REGSYS AVR relays operate all five transformer tap changers independently keeping circulating currents to a minimum. An advantage of this system is that only one transformer at a time

changes taps rather than all changing simultaneously in the bank control system. This reduces voltage step changes, improving voltage quality. Implementation of the a-eberle REGSYS relays has provided an innovative solution to the load sharing difficulties at these substations, thereby delaying capital expenditure for replacement of the three non-identical older transformers at Happy Valley. This effective extension of service life has significant economic benefits through the deferral of major capital expenditure.

MULTIPLE APPLICATIONS AND FEEDBACK

The REGSYS associated software (WinReg) is intuitive to operate and simplifies commissioning and operation. Even parallel operation is straightforward to implement, once the user has familiarised themselves with the procedures discussed in the manual. Alternate solutions using Programmable Logic Controllers (PLCs) are far more difficult to design, implement and maintain. REGSYS AVR relays have the added advantage that they are a fourth generation product optimised through multiple applications and feedback from many European users. PLC programs however are a first generation product, known intimately by only the PLC programmer, and likely to present problems in the future in contingencies not foreseen by the designer and PLC programmer.

REGSYS AVR relays also have the capability for remote operation and ElectraNet have successfully installed this function using an engineering communications server. The remote operator has a full on-screen display of the relay panel and can adjust all functions, just as if they were in front of the relay.

Due to the versatility of the a-eberle system, subsequent ElectraNet designs have very few auxiliary relays. This facilitates simpler drawings, standardization, installation and commissioning, as well as affording noticeable space savings in the relay panels.

OPTIONS FOR FURTHER IMPROVEMENTS

The a-eberle REGSYS voltage regulating system affords flexible options for further improvements to this installation in the future. A new 66kV connection into the Happy Valley MVE 66kV system is now being designed and the a-eberle relays will allow this new line to be added with little change to the existing five a-eberle relays or programs within them. The only new work to be carried out involves the installation of an additional a-eberle relay onto the new transformer feeding the new 66kV line, and communication between this relay and the existing five. The ease of designing in this new 66kV line would not be possible with a PLC type system.

ADDITIONAL CAPABILITY

Unique capabilities of these relays allow for a blocking system for transmission voltage collapse should this be required (using a voltage sag detection system, and an alternative method using sophisticated bifurcation theory) and also remote monitoring of transformer oil and gas condition, and service life through the IEC 354 standard it implements.

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