ABSTRACT

Electromechanical protective relays have been employed for many decades with success for the protection of electrical power systems. In the course of time, this equipment has been perfected to such an extent that its development at present time may be regarded as practically complete. Relay protection for today's power systems must be engineered to provide more comprehensive coverage for more contingencies than previously could be justified. The increasing size, complexity and power ratings of modern high voltage networks call for protection schemes which are fast, selective and highly reliable. These also need a closer control of the protection characteristic calling for the development of relays which provide novel characteristics that are not obtainable with the electro-mechanical relays. Solid state components have opened up new possibilities and approaches to achieve the above mentioned objectives. The use of proven digital and integrated circuits paves way for highly sophisticated designs with their associated advantages of compactness and flexibility, in design and in application. Consequently, for more than two decades, work has been in progress replacing the electromechanical units with versions which are free of the shortcomings. Thoroughly new concepts, hitherto not possible with electromechanical

versions have resulted in novel operating characteristics, facilitating thereby the synthesis of the protective relay characteristic suited to system requirements.

The present work forms a continuation of this trend and exposes new developments in multi-input phase and hybrid comparison techniques for distance and pilot-wire protection schemes. The comparison techniques expose the possibilities of tailoring the conventional quadrilateral and conic characteristics and novel self-adjusting characteristics to suit the varying conditions of the power system. The present work also includes the generalisation of a class of phase comparison techniques and its application to distance and pilot-wire protection schemes, and the developments in the restricted zone protection of short transmission lines.

The system requirements and the necessity for shaping the pick-up characteristics of distance relays are analysed in detail. Theoretical basis, design principles, typical discriminating and logic circuits have been described for each relay unit and the theory confirmed by laboratory tests.