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## ***Abstract***

In recent years, a new technology – Flexible AC Transmission Systems (FACTS) is introduced in the power system. This technology could increase the transmission line capability, control the power flow, and enhance the transient stability of the power system effectively. Due to the injection of the FACTS components; the line parameters of transmission system will be changed. Therefore, the power system protection relay's operation will be influenced.

This dissertation explores an apparent impedance calculation procedure for transmission line incorporating Static Synchronous Compensator (STATCOM) (which is a vigorous component of FACTS) based on the power frequency sequence circuits. A detailed model of 6 pulses STATCOM and its control and a mho relay model are proposed and integrated into the transmission system using Power Systems Computer Aided Design (PSCAD) software.

The simulation results of the application of conventional distance relay for the protection of transmission line incorporating STATCOM are presented. The simulation results carried out by PSCAD software and the analytical calculations show the impact of STATCOM on the distance protection relay during the different fault condition.

The influence of location of STATCOM, the setting of STATCOM's reference voltage and the operation mode of STATCOM on mho distance relay are studied as well. The results are presented in relation to a typical 220kV, 450Km (Atbara-Portsudan) transmission system employing STATCOM at the midpoint.

## مستخلص

في الأعوام الأخيرة تم تقديم تقنية مستحدثة في أنظمة القدرة الكهربائية وهي أنظمة نقل التيار المتردد المرنة (FACTS) ، هذه التقنية بإمكانها زيادة مقدرة خط النقل و السيطرة على تدفق الطاقة وايضا تعزيز استقرار الحالة العابرة لنظام القدرة بكل فعالية. نظراً لحقن مكونات هذه التقنية سيتم تغيير عوامل نظام النقل، لذلك سوف يتأثر عمل مرحلات الحماية المسافية لنظام القدرة.

هذا البحث يوضح طريقة حساب المعاوقة الظاهرة للمرحل المسافي لخط نقل مدرج به معوض متزامن ساكن (STATCOM)، وهو أحد العناصر القوية في عائلة أنظمة نقل التيار المتردد المرنة) استناداً لدوائر التردد المتسلسلة، و من ثم تم اقتراح نموذج مفصل لمعوض متزامن سداسي النبضات مع تحكمه و مرحل حماية مسافي (mho relay) ودمجها في نظام النقل ومحاكاتها باستخدام برمجة محاكاة أنظمة القدرة (PSCAD).

تم عرض نتائج المحاكاة لتطبيق المرحل المسافي التقليدي لحماية خط نقل مدرج به معوض متزامن ساكن (STATCOM). النتائج المستخرجة من المحاكاة والمستخرجة من الحسابات التحليلية اظهرت أثر المعوض المتزامن الساكن على مرحل الحماية المسافي اثناء حالات الأعطال المختلفة.

المحاكاة شملت ايضا تأثير موقع المعوض المتزامن الساكن وأثر تغيير قيمة الجهد المرجعية له وأثر تغيير نمط عمله على عمل مرحل الحماية المسافي. النتائج المعروضة حُصّلت باستخدام خط نقل بجهد ٢٢٠ كيلوفولت وطول ٤٥٠ كيلومتر (خط نقل عطبرة- بورتسودان).

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