Grey wolf optimization based improved protection of wind power generation systems

ABSTRACT

Proper design of wind farm power system protection is an immensely challenging task for electrical power protection engineers which must be accomplished thoroughly to provide an adequate protection for power apparatus in case of fault incidence. Overcurrent relays (OCRs) are the most crucial protection tools for wind farms which are responsible for protecting power systems from faults. These relays need to be properly coordinated with each other and their settings function should be according to IEEE or IEC standards. During a fault occurrence in the wind farm especially, in the intertie section, several OCRs operate instead of a designated relay to that particular fault location, which would cause unnecessary power loss and disconnection of healthy feeders out of the wind farm that makes the situation tremendously ominous. Thus, this research proposes a novel grey wolf optimizer (GWO) based optimization technique for proper coordination of OCRs to gain improved protection of wind farms. GWO have ample advantages compared to other intelligent algorithms including, fast response, high accuracy and most notably attaining optimal solutions for nonlinear characteristics of OCRs. In this work the improvement in protection of wind farm is realized through optimizing the relay settings, reducing their operation time and time setting multiplier of each relay, improving the coordination between relays after implementation of IEC 60255-151:2009 standard. The results show that the new approach is able to achieve significant improvement in operation of OCRs at the wind farm and diminish the total operation time of the relays significantly.

Keyword: Grey wolf optimization; Wind farm; Power system protection; Overcurrent relay; Relay coordination