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DAR ENGINEERING

WIDE AREA PROTECTION: BENEFITS, SCHEMES & EXAMPLES

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Modern power systems are almost typical with regards to reduced redundancy and operating close to, or even at, their security limits. Today the power system is more vulnerable to a blackout more than ever before. Wide-area disturbances and large-scale outages could occur by the system deteriorating into a terminal state, starting from a single or multiple outages and cascading into an avalanche of outages. Conventional protection and control systems are the only means of counteracting such disturbances, and/or mitigating their effects. The main disadvantage of the present conventional method of system monitoring and control is the inappropriate system dynamic view, i.e. no operator has the full view picture of what's happening in the network. Also blackouts, wide-area disturbances, etc., may develop in such short times, quicker than the time the operator would take analyzing and deciding which action to take and acting it.

The local actions are uncoordinated in nature, like that in decentralized protection devices, or even in load shedding schemes that might operate in conjunction with generator rejection schemes. Hidden failures in protection relays and mal-operations of protective schemes also play a major role in the deterioration of situations.

The above conclusions were realized after studying any of the previously occurred wide-area disturbances or major blackouts. Hence the need of the introduction of smart, wide-area-perspective schemes which rely on state-of-the-art, recently developed communication and computer infrastructures.

While local protection relays and devices operate through short times, these actions are certainly uncoordinated. Coordinated actions will be taken through SCADA/EMS systems by operators, however in prolonged times, which might make the situations too late to rescue. Wide Area Protection (WAP) systems provide a very promising future in the face of wide-area disturbances and blackouts, as they fill in the gap between local, fast protection actions and wide-area, slow control-centers actions.

Phasor measurement technologies now allow accurate comparison of measurements over widely separated locations as well as potential real-time measurement based control actions. Hence WAP systems could be employed to fulfill the two main objectives of increasing transmission capability as well as increasing system reliability, by performing a real-time, look-ahead analysis giving some recommendation of possible updated control strategies and actions, especially in the events of contingencies. The WAP system shall know what actions to take based on the present system condition in the case that a certain contingency occurring, or would take an action saving the system progressing into an unstable state.

This paper presents a literature survey on the topics concerned with the applications of synchrophasor-based Wide Area Protection systems. Firstly, a brief preview of the current existing conventional protection, control and SCADA/EMS systems is presented. Through a survey, several cases of wide-area disturbances are presented while emphasizing the potential of implementing the new WAP systems as appropriate solutions and preventive measures against the wide-area disturbances and blackouts. Definitions of WAP and the current directions for implementing the WAP systems are presented, through different architectures, already demonstrated through previous literature, in addition presenting the possible practical ways of implementation in the current modern grid. A quick look at the aiding technologies that allow the implementation of such WAP systems will be taken, including data processing, data collection and communications. A summary of examples of the WAP systems, either practical, or novel-based will also be previewed in this paper, as an effort from the authors through the surveyed literature.

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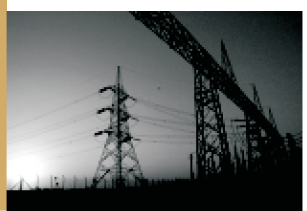

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