

Discussion Deadline: January 2002

Measurement of Network Harmonic Impedances: Practical Implementation Issues and Their Solutions

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Abstract: Determination of network harmonic impedances using pre- and post-disturbance steady-state waveforms is a well-known technique. Due to practical constraints, however, it is not quite straightforward to implement the technique for real-life applications. Using an actual utility case as an example, this paper presents practical implementation issues involved and their solutions. Improvements are made to the technique by applying 0 transformation on three-phase measurements. The usefulness of the improved technique is demonstrated with simulation and field measurement results. Since the technique only requires steady-state data, it can be easily implemented with many common power quality meters. One of the applications of the technique is to determine the existence of resonance conditions for shunt capacitor applications.

Keywords: Harmonics, harmonic impedance and harmonic resonance.

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Reliability Cost/Worth Assessment of Distribution Systems Incorporating Time Varying Weather Conditions and Restoration Resources

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Abstract: This paper presents a time sequential simulation technique incorporating the effects of weather conditions and restoration resources in reliability cost/worth evaluation of distribution systems. Time varying weight factors (TVWF) are introduced to represent the effects on component failure rates and restoration times of weather and available restoration resources. The average failure rate is combined with the TVWF to create time varying failure rates (TVFR) for each component. The average restoration time is combined with the TVWF to create time varying restoration times (TVRT). Studies conducted in a test distribution system show that the TVFR have large impacts on the interruption costs of frequency sensitive customers and slight effects on others. The TVRT have significant effects on the indices for all the customers. It is therefore important to consider TVRT in evaluating reliability cost/worth of network reinforcement.

Keywords: Distribution systems, reliability cost/worth, network reinforcement.

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Feeder Switch Relocation for Customer Interruption Costs Minimization

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Abstract: Most electricity service interruptions are due to failures in the distribution network. In a competitive market, service quality and reliability have become an essential part of the business. In order to enhance the reliability in the distribution system, a value-based method is proposed in this article to take load distribution changes into account and search for new locations of feeder sectionalizers such that the customer interruption costs (CIC) can be reduced. Two stages are involved in the search. Using local information, the first stage determines the search direction, and in second stage, it decides whether a crossover of the load point is beneficial. To avoid being trapped in a local minimum,

a mutation technique is also applied to look for the global optimum. Actual feeders were used in the tests and test results have shown that with a proper adjustment of the feeder sectionalizers, service reliability can be improved and the customer outage costs are reduced.

Keyword: Distribution reliability, SAIDI, sectionalizer relocation, customer interruption cost, value-based planning.

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Sparse Network Equivalent Based on Time-Domain Fitting

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Abstract: This article presents an approach for a network equivalent calculation for the analysis of electromagnetic transients in power systems. It is based on time-domain fitting and enforces some degree of sparsity while preserving the accuracy of the equivalent. The calculated equivalent is appropriate for direct interface with the rest of the system in time domain. A constrained least squares solution of the time-domain fitting equations is used to ensure accuracy at zero and 60 Hz. Results demonstrating the accuracy and computational efficiency of the method are presented.

Keywords: Network equivalent, electromagnetic transients, time-domain fitting, discrete time, constrained least squares.

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Optimal Feeder Routing in Distribution System Planning Using Dynamic Programming Technique and GIS Facilities

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Abstract: Optimal feeder routing is an important part of the general optimal distribution network planning. This article proposes a new algorithm for the optimal feeder routing problem using the dynamic programming technique and GIS facilities. All practical issues, such as cost parameters (investments, line losses, reliability) and technical constraints (voltage drop and thermal limits), as well as physical routing constraints (obstacles, high cost passages, existing line sections), are taken into consideration. The algorithm developed is validated comparing its results for a simplified study case with those obtained by an established solver. The effectiveness of the algorithm is further illustrated for a "real world" study case.

Keywords: Planning, power distribution planning, routing, dynamic programming, geographic information systems.

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Power Disturbance Classifier Using a Rule-Based Method and Wavelet Packet-Based Hidden Markov Model

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Abstract: This article presents a novel classification method for power distribution line disturbances using a rule-based method and a wavelet packet-based hidden Markov model. The rule-based method is utilized for the classification of time-characterized-feature disturbances, and the wavelet packet-based hidden Markov model is utilized for the frequency characterized feature power disturbances. This proposed method classifies six types of actual recorded power distribution disturbances, i.e., sag, interruption, fast capacitor switching, capacitor switching, normal variation, and impulse disturbance, and obtains 98.7% correct classification rate for 670 actual disturbance events tested.