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Power Flow in Four-Wire Distribution Networks - General Approach

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The neutral wire in most power flow software is usually merged into phase wires using Kron's reduction. Since the neutral wire and the ground are not explicitly represented, neutral wire and ground currents and voltages remain unknown. In some applications, like power quality and safety analyses, loss analysis, etc., knowing the neutral wire and ground currents and voltages could be of special interest. In this paper, a general power flow algorithm for three-phase four-wire radial distribution networks, considering neutral grounding, based on backward-forward technique, is proposed. In this novel use of the technique, both the neutral wire and ground are explicitly represented. A problem of three-phase distribution system with earth return, as a special case of a four-wire network, is also elucidated. Results obtained from several case studies using medium and low voltage test feeders with unbalanced load, are presented and discussed.