This paper applies a new technique for modal decomposition based solely on measurements to test systems and demonstrates the technique's capability for partitioning a power network, which determines the points of separation in an islanding strategy. The mathematical technique is called the Koopman mode analysis (KMA) and stems from a spectral analysis of the so-called Koopman operator. Here, KMA is numerically approximated by applying an Arnoldi-like algorithm recently first applied to power system dynamics. In this paper we propose a practical data-driven algorithm incorporating KMA for network partitioning. Comparisons are made with two techniques previously applied for the network partitioning: spectral graph theory which is based on the eigenstructure of the graph Laplacian, and slow-coherency which identifies coherent groups of generators for a specified number of low-frequency modes. The partitioning results share common features with results obtained with graph theory and slow-coherency-based techniques. The suggested partitioning method is evaluated with two test systems, and similarities between Koopman modes and Laplacian eigenvectors are showed numerically and elaborated theoretically.