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## Highlights

- Joint energy and reserve market clearing using robust reliability constrained unit commitment (RCUC).
- Integration of demand response uncertainties in reserve market clearing.
- Information Gap Decision Theory (IGDT) application to make robust decisions against demand side participation uncertainties.
- Proposing a computationally tractable robust energy and reserve market clearing considering reliability measures.

**Abstract** Responsive loads, according to their increasing penetration, short response rate and flexibility are important sources of reserve in the smart power systems. Although in recent years demand response (DR) contribution in the (reserve) electricity market has been widely accepted with an important role in the reliable and economic operation of power systems, due to uncertain availability, sheddability, and controllability of these sources their uncertain behavior is worth to be investigated. For this purpose, at first, a reliability-based unit commitment is solved and then the results are used to clear reserve market in the presence of uncertain responsive loads based on information gap decision theory (IGDT) concept. Responsive loads are considered as reserve providers which participate in the market by offering their price-quantity capacity bids to the reserve market. The proposed method does not minimize the reserve market clearing cost, but with regard to the minimum cost, assesses the risk aversion or risk-taking nature of different strategies and also measures the related risk/immunity cost. Using this method, the system operator can select the best strategy according to the desired risk level, taking into account demand side uncertainty. Proposed method has been simulated over the 24 bus IEEE Reliability Test System.

**Keywords** Demand response; Information gap decision theory; Reserve market; Uncertainty; Smart grid.