Modelling and Assessment of the Capabilities of a Supermarket Refrigeration System for the Provision of Regulating Power

This report presents an analysis of the demand response capabilities of a supermarket refrigeration system, with a particular focus on the suitability of this resource for participation in the regulating power market. An ARMAX model of the system is identified from experimental data, and the model is found to have time constants at 10 and 0.12 hours, indicating the potential for the system to provide flexibility in both the long- and short-term. Direct- and indirect-control architectures are employed to simulate the demand response attainable from the refrigeration system. A number of complexities are revealed that would complicate the task of devising bids on a conventional power market. These complexities are incurred due to the physical characteristics and constraints of the system as well as the particular characteristics of the control frameworks employed. Simulations considering the provision of up- and down-regulation reveal that allowing the system to occupy any state within its feasible region results in a complex behaviour. This would require intensive monitoring and control and would be excessively complicated to communicate to a market operator. By restricting the operating region of the system this behaviour can be simplified. These restrictions result in a loss of optimality, but a result in a resource that can be communicated to the market operator in the form of a bid containing a quantity of power for up- or down-regulation and the duration for which the service can be provided.