Renewable Energy and Power Quality Journal (RE&PQJ), ISSN 2172-038 X, No.9, 12th May 2011, Reference Paper: 564

Perspectives of Demand-Side Management in a Smart Metered Environment

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Abstract. Some distribution system operators (DSOs) - among them all Hungarian DSOs - have installed extensive demand-side management (DSM) infrastructure in order to be able to perform peak-clipping and valley-filling of the daily load curves. These systems rely either on the traditional ripple control (RC) or radio ripple control (RRC) technology. In this paper a short overview on the capabilities of these methods will be given, and compared to the DSM possibilities offered by Smart Metering (SM) based systems. In the focus of the paper a new modelling framework will be presented, which makes it possible to simulate the consumer behaviour on an appliance level in different DSM environments. The effects of direct DSM methods (like RC or RRC) and soft DSM (dynamic tariff systems) on the daily load curves will be analyzed in order to exploit the possibilities of SM systems.

Keywords

DSM, Smart Metering, Ripple Control, Radio Ripple Control, Consumer Behaviour Modelling, Household Appliance Models

1. Introduction

The power community is facing worldwide discussions about Smart Metering (SM) technology, the possible system structures and benefits to be expected from different SM systems. The 2006/32/EC directive prescribes the monthly reading and billing of the electric power consumption, this is why the different SM technologies are in use or under development (pilot projects) in several EU member countries.

This paper focuses on DSM issues and aims to contribute to SM systems design in the planning stage in order to enlarge the possibilities of a prospective metering infrastructure.

2. RC and RRC

A. The application of RC in Hungary

The Ripple Control system is a telegram based DSM system, where the carrier is the 50 Hz distribution network. In Hungary the application of the system has been started in 1975, basically for switching on and off boilers (electric storage water heaters) and high capacity storage space heaters. In the beginning of the 2000's the controlled power was approx. 1500 MW, which is one fourth of the winter peak load. [1], [2]

Applying RC system, hundred thousands of customers can be controlled from one place, as the sending device can be installed on any voltage level from LV to HV. The addressee can be either only one consumer, or a group of them. [3]

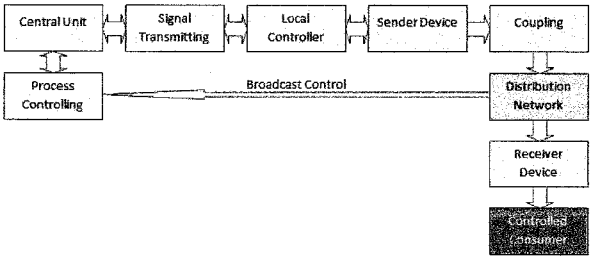

Fig. 1. The Ripple Control (RC) system

The simple structure (Fig. 1) could incur some possible problems, which are disadvantageous: [3]

- *One-way communication:* the DSOs do not have any reply from the addressees whether they received the message and fulfil the switching order or not?
- *The distribution system is planned to transmit 50 Hz waveform:* the transmission of other frequency components is not ideal.

Nowadays the RC system is used for the following purposes in Hungary: [3]

- *Basic controlling:*
  - Tariff shift
  - Public lighting
- *Customer's load controlling:*
  - Boilers
  - Electric storage space heaters
  - Air conditioners
- *Other controlling purposes:*
  - Civil defence siren
  - Factory switching
  - Building and advertisement lights

The control is based on sending standardized telegrams. The task of the Sender Device is to generate the message