

Smart Energy Meter “A Device To Measure The Frequency Deviation And Power Quality Measurement”

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Abstract— These Smart energy meter are used to control domestic load during system emergencies. Because of communication delay of 10ms, it is unable to provide primary frequency response by direct load control through smart meters. In order to avoid direct load control method, a controllable scheme was made that uses smart energy meter in order to provide frequency measurement. For this scheme, easily available commercial components were used. By the help of smart energy meter the speed at which the frequency is measured can be increased with more accuracy from around 3s to 200ms.

Smart energy meter can also be used to give the power quality related measurements.

Index Terms— DLC(direct load control)

1 INTRODUCTION

A balance between the generation and demand determines the frequency in an AC system. If there is no balance between generation and demand than the frequency changes rapidly. If the frequency of the system changes than the power output of the prime movers of the generating system changes. With the help of inertia of rotating masses of the power system the initial rate of frequency changes can be measured.

The steady state system frequency limits to $50 \pm 0.5\text{Hz}$ [1]. If the load is increased than the frequency is decreased which should be maintained at 48.8Hz within minimum time i.e. 1 min.

National grid electricity transmission plant uses frequency responses in order to maintain the frequency. If the frequency goes high than it can be reduced by using primary frequency response which can be maintained for 10 sec to 20sec (Fig. 1.) [2]. The system is brought back to the normal state by means of a secondary response which last for 30sec to 30 min. If the frequency drop below 48.8Hz than the demand is disconnected to prevent the shutdown of the system [3].

Smart energy meter is introduced in power system that is used to provide the real time energy consumption and cost information to the customers so that they can reduce their energy consumption. With the help of this peak demand of energy can be reduced.

Today, Smart energy meter can provide good quality of power that is needed in today's world as power quality has been increased in electrical system so it become important to have a equipment that can measure the power quality as well as can provide information about the real time power consumption.

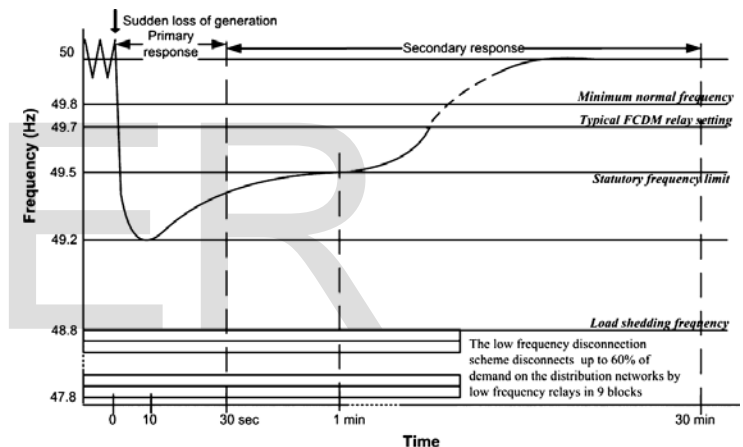


Fig. 1. Primary and secondary frequency response

2 CONTROLLABLE SCHEME

Here Smart energy meter has the capability of shutting down the direct load by using direct load control (DLC) scheme to maintain the balance between the supply and the demand [4]. But in this scheme there was a communication delay of 10ms. That why a controllable scheme (Fig. 2.) was made which consist of smart energy meter, controllable loads and smart sockets that communicated through a home area network[5]. Smart controllable loads consist of different types of loads such as inductive, capacitive, temperature dependent device etc. when the loads in the load controller will increased or decreased than there will be a change in the frequency. If the loads in the load controller will increased than the frequency will decreased and if the loads in the load controller will decreased than the frequency will be increased. This frequency will be measured by the smart energy meter and will be stored in its internal register. According to this frequency, different loads will either be switch on or switch off. After reading the

frequency, an algorithm will run and then then it will decide which loads should be switched off and which should be switched on. Then the smart load controller will send the control signal to the smart sockets over the home area networks and according to the control signal the smart sockets will switched the appliances. The steady state system frequency limits up to $50 \pm 0.5\text{Hz}$. If the frequency is decreased than it should be maintained at 48.8Hz within 1 minute. And if the frequency is dropped below 48.8Hz than it will disconnect the loads so that the power system should not be shutdown.

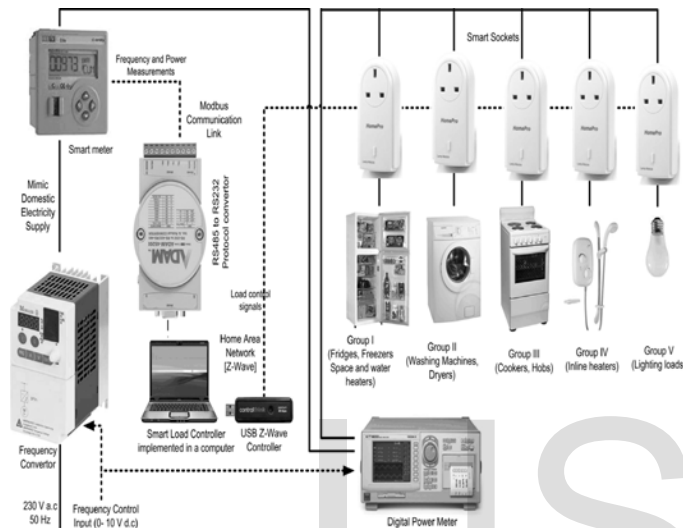


Fig. 2. Controllable scheme using domestics loads

3 POWER QUALITY MEASUREMENT

Today, quality of the energy deliver becomes main issue. So that protection and safety of the consumer's equipment can be guarantee. Equipment that can measure power quality and energy, become important as they can provide the real time information so that the problem in the installed equipment can be prevented [6] [7] [8].

Norwegian regulator has worked on new regulation regarding energy measurement. In this regulation voltage quality measurement is not mandatory but regulation of interruption is mandatory. It has been seen that the interruptions will not be registers in the energy meter according to the power quality factor such as EN50160 [9]. The Norwegian regulator has suggested that the meter should register an event when the voltage is below 115V . Smart energy meter is capable of providing power quality related measurements as well as can register the events.

3.1 Objectives To Test The Smart Energy Meter

SINTEF energy research has done research on the five energy meter belonging to the four different vendors. The power quality factor of each meter is different. The main target of this

research was to test the energy and capabilities of smart energy meter when used on a large scale in terms of power quality measurement. They have done research on today's market not on the future market.

4 CONCLUSION

Smart energy meter prove a efficient meter in providing a real time energy consumption and cost to the customers through 'In Home Displays'. According to this, customers can minimize their energy consumption. This is one of the best ways to conserve the energy. It can also provide the power quality related measurements.

Smart energy meter can measure the frequency according to the loads in the load controller and stored it into its internal register. According to this frequency loads can be decreased or increased so that the there is no disturbance in the power system. If the frequency is below 48.8Hz than the loads will be completely disconnect from the power system. In this way our electrical power system can be in proper working state without any disturbance.

Smart energy meter can also provide the power quality related measurements. The research done by the SINTEF research energy proved that when the voltage is measured continuously and the event is registered than there is a large difference between the meters that has been tested and the meters that has not been tested.

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