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Potential of demand response in Thailand

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Abstract:
The steady increase in the demand for electricity around the world, especially in developing countries has a serious impact on generating a reserve of the electrical system of the countries. This low reserve margin can cause a large damage to customers. Therefore, it is necessary to increase the electricity-generating reserve. This may be done by building a new power plant that would need high investments, could have huge effects on the environment, and usually causes social problems. Thus, many countries use Demand Response (DR) to reduce peak power. By changing the behavior of the consumer which respond to the electricity price and compensation from reduction of their peak demand. This study was to investigate the potential of using the DR in Thailand. The eight existing buildings in Bangkok has been audited and measured to get the electricity consumption characteristic and also the usage schedule of all the main equipment. The study found that the potential for DR can be categorized into two major groups of measures: 1) generator reserve and 2) reduction of building demand. Based on the analysis and evaluation of these buildings, the overall reduction is 3,940 kW from a 20,736 kW peak. Moreover, the study also found that the key issue to consider in the implementation of measures is impact on customers, availability, age and maintenance and costs of the generator.

Keywords: *Peak Demand Reduction; Demand Side Management; Demand response*

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1. Introduction

DR is a group of measures aimed at changing the behavior of the electricity consumer, mainly to reduce the peak of each customer during the peak period of the system (Bradly et al., 2013; Kim et al., 2011). DR can be classified into two main groups (Parsa et al., 2011; Paria and Vale, 2011; Dashti and Afsharnia, 2011). 1) Time-based DR programs: use of electricity price that varies with time of day to manipulate the pattern of use and 2) Incentive-based DR programs: use financial incentive to motivate the reduction of peak load of each customer. There are many schemes under that main group with various pros and cons. Therefore, before introducing DR in Thailand, it is necessary to evaluate the potential of these measures.

2. Material and methodology

The load profile of selected existing buildings collected power and energy consumption and operating pattern of the main equipment in each building. It was also verified in order to find out which equipment was used during the peak period of the system. After that, the equipment that operates in the peak period was studied in detail to reduce the consumption or moved to off peak period. This research started with exploring the experiences of various countries that already opted for DR including methodology, barriers, key success factors and data requirements.

Collecting data of the selected existing buildings including electrical consumption profile of the building, consumption and usage pattern of the main equipment and also the characteristic of thestandby by generator of each building. Identifying the potential of DR in each building based on the collected data.

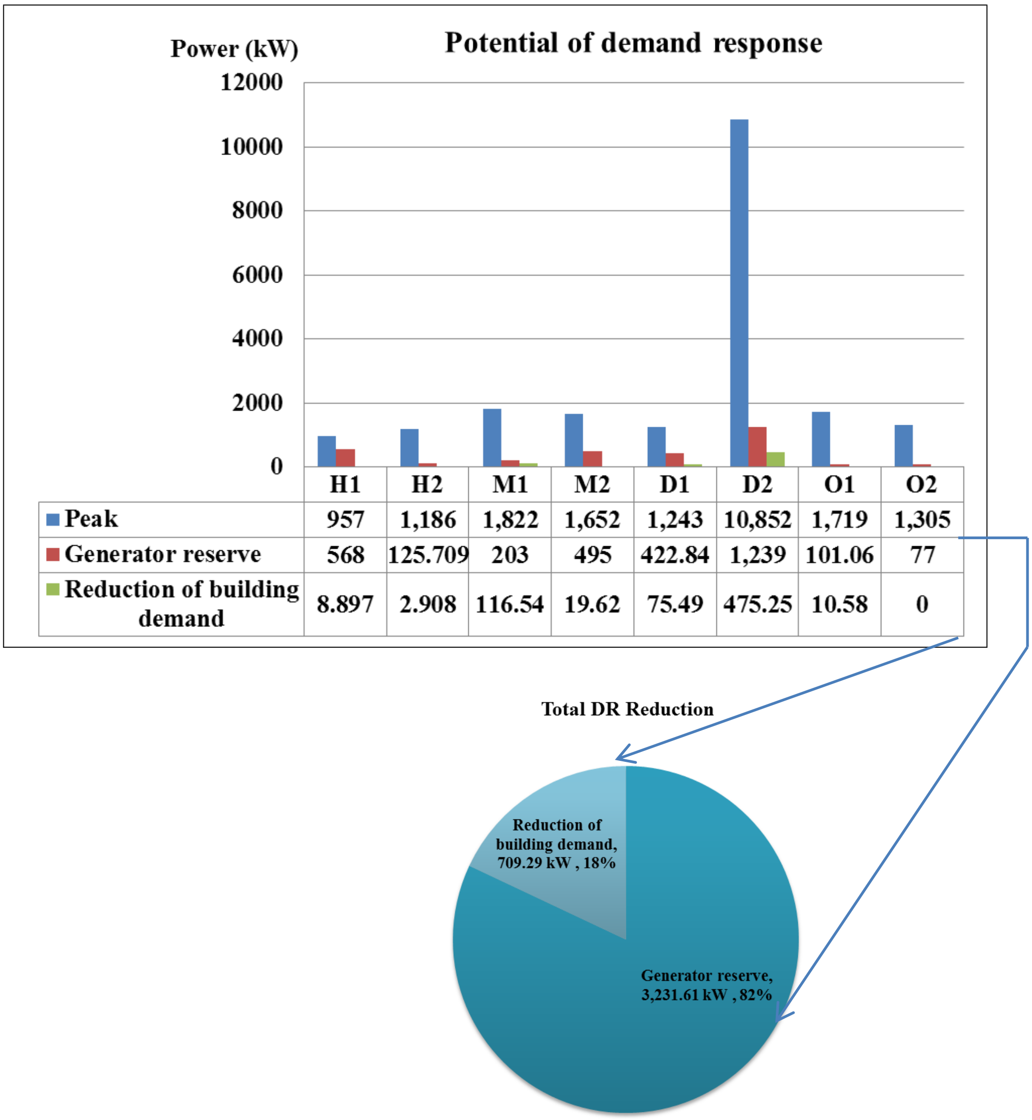
3. Results

The example building consists of two hospitals (H1, H2), two hotels (M1, M2), two department (D1, D2) and two offices (O1, O2). The results (Table 1) show that the potential measures can be divided into two main groups, namely generation reserves and peak reduction. The possibility of peak reduction of equipment depends on type and operating condition in each building varying from 1 to 6% of total peak. In general, the standby generator in the buildings in Thailand had no synchronized system to the grid. Therefore, they cannot reduce peak of the building with its full capacity but only the emergency load that is normally connected to it. This capacity varies from 6 to 60% of peak load.

Table 1 also shows expenses incurred in carrying out such measures. The main expense was the cost of fuel for the generator and installation of small control equipment such as variable speed blower or lighting control of equipment.

Table 1 The potential of each measure for each building

Measures	**Potential of DR**		
	Power Reduction (kW)	**Costs (THB/y)**	**Investments (THB)**
H1			
1. the reduction in speed in the cool air supply passage.	2.15	reduced 474	20,000
2. turning off Exhaust Fan	6.74	reduced 1,489	312,000
3. Generator reserve in system peak	568	increase 160,871	-
Total	**576.8**	**increase 158,906**	**332,000**
H2			
1. turning off lighting area	2.90	reduced 469	-
2. Generator reserve in system peak	125.70	increase 71,841	-
Total	**128.6**	**increase 71,372**	**-**
M1			
1.Reducing the speed of the motor BAHU.	55.94	reduced 8,896.47	-
2.turning off lighting area	60.6	reduced 9,637	90,000
3. Generator reserve in system peak	203	increase 88,297	-
Total	**319.54**	**increase 69,763**	**90,000**
M2			
1. Closing the air handling units for the corridor.	17.86	reduced 3,943	-
2.turning off lighting area	1.76	reduced 388.	-
3. Generator reserve in system peak	495	increase 131,285	-
Total	**514.62**	**increase 126,954**	**-**
D1			
1. PEAK DEMAND closure temperature range of countries.	58.16	reduced 12,840	-
2. DEMAND LIMIT adjustment measures of cold water	17.33	reduced 3,826	
3. Generator reserve in system peak	422.84	increase 119,758	-
Total	**498.33**	**increase 103,092**	**-**
D2			
1. Measures to reduce the use of chiller 1 of the PEAK DEMAND.	475	reduced 75,581	-
2. Generator reserve in system peak	1,239	increase 427,410	-
Total	**1,714**	**increase 351,828**	**-**
O1			
1. turning off lighting area	5.16	reduced 833	60,000
2. close the lift	5.42	reduced 874	-
3. Generator reserve in system peak	101	increase 36,455	-
Total	**111**	**increase 34,748**	**60,000**
O2			
1. Generator reserve in system peak	77	increase 36,091	-
Total of 8 buildings	**3,940**	**increase 952757**	**482,000**



	H1	H2	M1	M2	D1	D2	O1	O2
Peak	957	1,186	1,822	1,652	1,243	10,852	1,719	1,305
Generator reserve	568	125.709	203	495	422.84	1,239	101.06	77
Reduction of building demand	8.897	2.908	116.54	19.62	75.49	475.25	10.58	0

Fig 1. Potential measures to implement DR of each building.

Fig. 1 shows that the potential of DR varies from 6% to 60%. The potential of standby generator varies from 6% to 60% and the potential of demand reduction varies from 1% to 6%. The overall reduction of eight buildings is 3,941 kW compared to load at 20,736 kW with 82% from generator reserves and other 18% from peak reduction in the building.

4. Discussion

From the assessment of potential actions DR found that the generator itself had much higher potential to reduce peak than reducing the peak of the building. This is because the group of selected buildings is customer-oriented. Any measures that may affect this limitation may lower in other types of the building the customers were reacted.

5. Conclusion

To evaluate the potential to reduce peak demand of DR measures for two groups of measures: 1) generator reserve and 2) reduction of building demand. The main concern in the implementation of the measures is the effect on the customers and benefit from the implementation of the measures. Therefore, it is important to have an accurate inspection and data collection to calculate the suitable incentive rate before using DR at the national level.

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