IDENTIFICATION OF THE KEY FACTORS AND DEVELOPMENT OF STRATEGIES FOR PROMOTING RESIDENTIAL CUSTOMER PARTICIPATION IN DEMAND RESPONSE PROGRAMS

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Degree of Master of Science in Electrical Installations

Department of Electrical Engineering

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgment any material previously submitted for a degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text. Also, I hereby grant to the University of Moratuwa the non-exclusive right to reproduce and distribute my dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books)

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Date: 03/07/2024
(M.A.I.N. Chathurangi)

The above candidate has carried out research for the Masters Dissertation under my supervision.

Signature of the supervisor:

Date: 03/07/2024
(Prof . K.T.M.U. Hemapala)

ABSTRACT

Effective Demand Response (DR) design plays a crucial role in mitigating peak demand increases and price volatility. Understanding diverse customer behavior, particularly in the residential sector, is pivotal for successful DR implementation. Recently, there has been a growing focus on price-based demand response programs, offering increased flexibility and potential for enhanced demand responsiveness. The success of these programs hinges on encouraging greater residential customer participation, necessitating the formulation of more effective incentive schemes. DR programs, including direct load control, empower utilities to manage peak loads by temporarily reducing electricity demand. While the efficacy of direct load control on individual appliances is well-established, utility demand-side management strategies often integrate multiple DR programs to optimally reduce demand during peak events.

Power distribution transformers are one of the key assets to be managed by the utility. The aging of transformers causes operational and financial burdens on the utility. Insulation failure due to overloading is the primary cause of the aging of the transformer. In Sri Lanka high peak demand appears at nighttime due to the residential loads are increasing. Therefore, the transformers are overloading at nighttime. Instead, the concept of demand response can be used to reduce the transformer overloading at the nighttime peak considering the requirements of the load. In this, I have demonstrated how Demand Response can positively affect the lifespan of the transformer.

To characterize the psychological behaviors of the customer by analyzing the conduct of a customer survey among the residential customers of the overloaded feeder. From this, the available capacity of DR can be measured. The consumer willingness to participate in DR is also measured by identifying the key factors the customer expects to participate in such program.

After that, analyze the customer load profiles and transformer load profiles to find the necessary load reduction in the night peak.Finally, based on the available capacity, a DR scheduling model is developed.

Then, according to the scheduling results, an incentive scheme is proposed to evaluate the impact of DR on generation adequacy and analyze the benefits to the utility and the customers who participated in DR.

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LIST OF ABBREVIATIONS

Abbreviation	Description
PUCSL	Public Utilities Commission of Sri Lanka
LECO	Lanka Electricity Company Private Limited
CEB	Ceylon Electricity Board
LV	Low Voltage
MV	Medium Voltage
DR	Demand Response