DEMONSTRATION PROJECT OF DISTRIBUTION LEVEL MICROGRID IN PENETNAGUISHENE OF CANADA

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ABSTRACT

In this paper, we summarized the demonstration project in Penetanguishene of Canada. Penetanguishene area i s located 150km north of Toronto and a small remote ar ea which is about 10,000 populations. This area has pro blems of maintenance and extension cost for transmissio n network and those affect the profitability of distributio n utility. To solve the problems, KEPCO and PowerStre am, launched the demonstration project. The demonstra tion project is divided into two stages. One is for the de monstration of isolated operation for feeder level, custo mization of MG operation system for North American m arket, control of active distribution network, peak shavi ng and valley-filling, and protection issue from long-term isolating operation. The other is the additional R& D demonstration for actual business. This is for the dem onstration of trade of demand resources (VPP, market s ervice), prototype business model application, long term isolating operation and Etc.

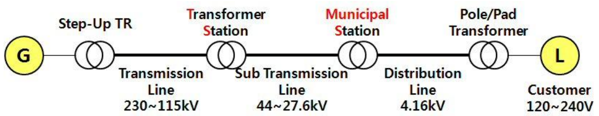
INTRODUCTION

According to the IEEE, a microgrid is defined that the in tegrated energy system network consisting of distributed energy resources (DER) and multiple electrical loads an d/or meters operating as a single, autonomous grid either in parallel to or islanded from the existing utility [1]. A nd the type of microgrid is divided into the utility, comm ercial and isolated microgrid. Utility microgrid is that w hole or part of distribution network is operated independ ently of other distribution network. In this network, ESS and DER is utilized for energy self sufficiency and high reliability. The operation system is advanced than conve ntional distribution operation system and the various app lication programs for enhancement of network operation reliability and efficiency are mouted. The size of UDM (utility distribution microgrid) is substation or distributi on feeder level and the operation object is for the advan ced distribution operation and reliability enhancement us ing commercial microgrid resources and VPP/DR resour ces.

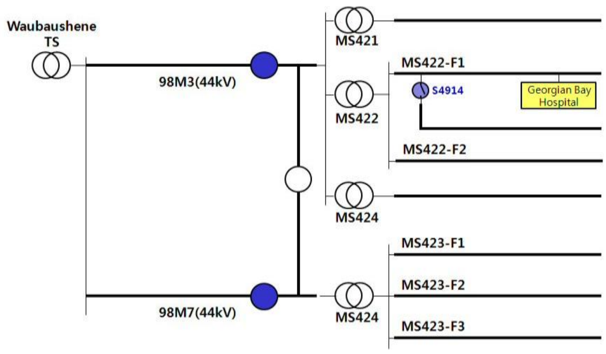
KEPCO (Korean Electric Power Corporation) has been developed for the core technical solutions for UDM. Th at is focused on the KEPCO’s own UDM operation syst em platform and application and UDM engineering tech nology. The business strategies of KEPCO for microgrid are divided into the basic, technology intensive and futu re type. Their objects are the electrification of developin g country, the production and sales of electric power and water using MG (microgrid) and the business model of high end market, respectively. Since 2014, KEPCO coo perated with PowerStream that is Canadian distribution company for the obtainment and field test of future type MG. The cooperation project is titled Penetanguishene Distribution MG Project and the duration is from March 2015 to February 2017. The target area is Penetanguish ene, Ontario. The final goal of the project for KEPCO is the demonstration site construction and the obtainment of track records for KEPCO’s UDM operation system.

CURRENT STATUS OF PENETANGUISHENE

The network hierarchy of PowerStream and Penetanguis hene are illustrated in Fig. 1. As shown in Fig. 1, Peneta nguishene area feeds from Waubaushene substation (23 0/44kV) and It has 4 municipal station (MS421~424). K EPCO’s MG is constructed on MS422 feeder 1.



(a) PowerStream network overall



(b) Penetanguishene network

Fig. 1. Network Hierarchy

MS422 feeder 1 is typical radial network and it has relat ively many interconnections with other feeders and subst ations by manual switches. The main transformer is 5/6. 5 MVA capacity and 44/4.16kV voltage. The length of t he feeder is about 2.04km and the protection device is fe eder breaker only. The total contract power of the feeder is 7,265kVA and the annual peak loads is 1,820 kW. 3. 02MVAr capacitor bank is installed at primary side of MS422 station.

Penetanguishene area is traditionally experiences a lot of power outages due to the transmission line faults. There fore, we focused on the uninterrupted island operation, customization of KEPCO's MG operation system, active distribution operation, peak shaving and long term island operation. The final demonstration item is shown in Table 1.

Table 1. Demonstration items of Penetanguishene Prj.

No	Benefit	Solutions by Demo
1	Increase of selling price	Improvement of power quality and reliability using variety DMS functions (state estimation/voltage optimization) and FDIR using ESS
2	Decrease of Purchasing price	ESS daily scheduled operation that based on electricity price and ESS yearly schedule operation for the reduction of peak load
3	Expansion of EPC business	Reduction of the intermittency of DGs in terms of PCC point power flow

The demonstration site is shown in Fig. 2.

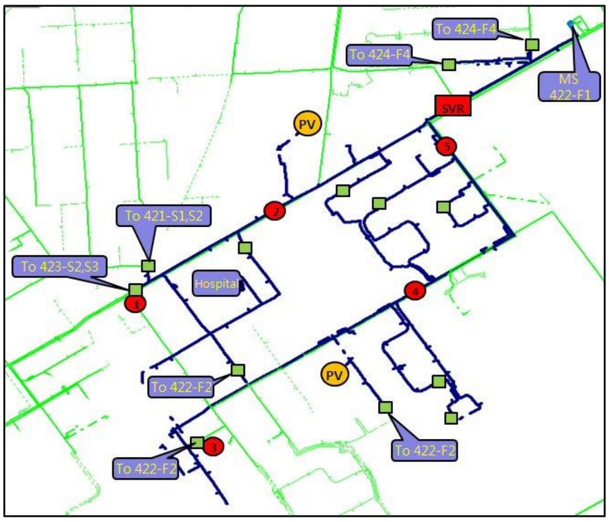


Fig. 2. Demonstration site design

The network diagram for installation of ESS/PCS is illustrated in Fig. 3.

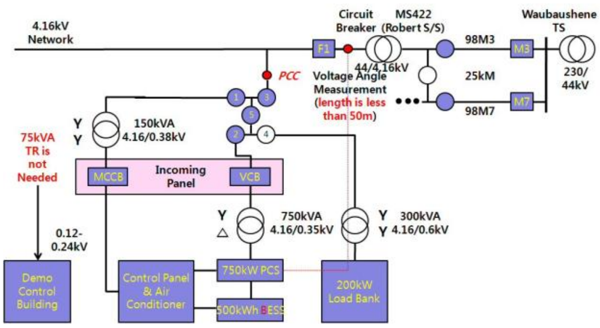


Fig. 3. ESS/PCS network diagram

The structure of UDM operation system is shown in Fig. 4. That is 1 machine structure.

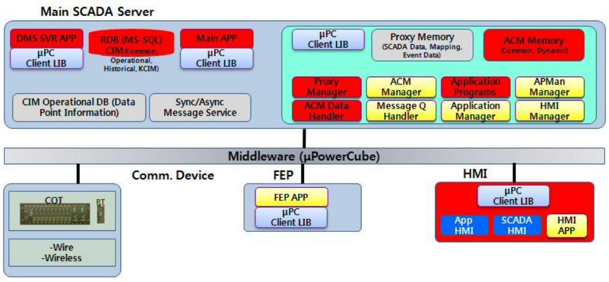


Fig. 4. Structure of UDM operation system

Fig. 5 describes the communication network diagram for Penetanguishene project.

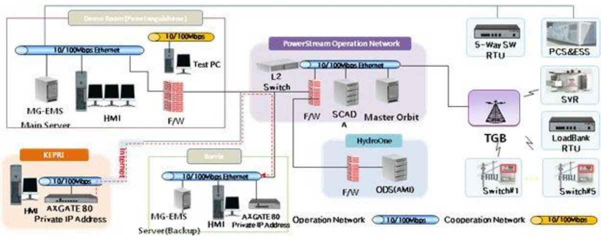


Fig. 5. Communication network diagram

DEMONSTRATION SITE CONSTRUCTION

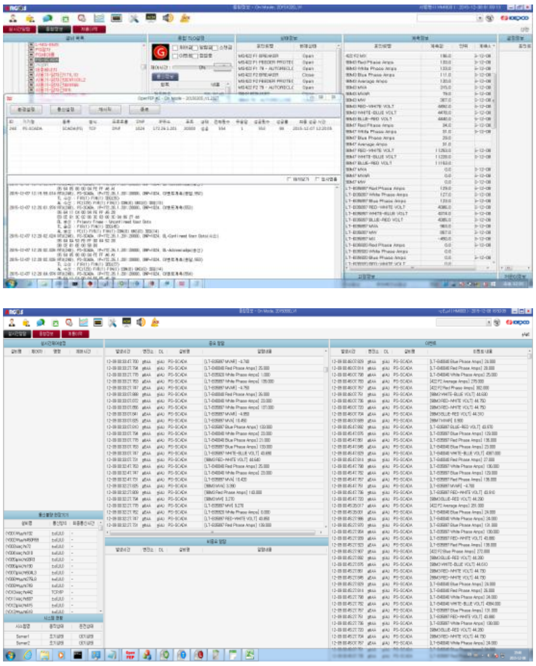
Fig. 6 shows the demonstration construction.


(a) MG control room

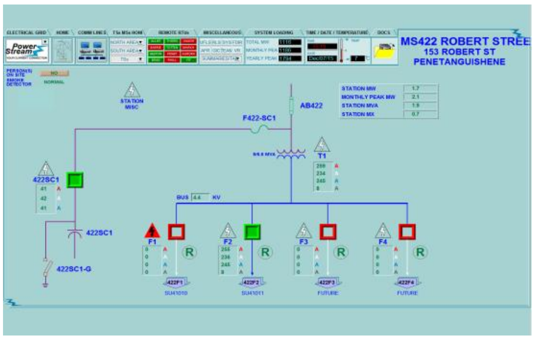

(b) Pad for container and incoming panel

(c) Installation of ESS/PCS
Fig. 6. Photos of site construction

Fig. 7 shows the basic communication test for MG operation system. More detail test results will be finished until June 2016.



(a) PowerStream's SCADA Interconnection



(b) Control of MG system through PS SCADA
Fig. 7. Test results of MG operation system

REFERENCES

[1] J. Driesen and F. Katiraei, 2008, "Design for Distributed Energy Resources", *IEEE Power&Energy Magazine*, 30-40.
[2] B. Kroposki et al., 2008, "Making Microgrids Work", *IEEE Power&Energy Magazine*, 41-53.
[3] F. Katiraei et al., 2008, "Microgrids Management", *IEEE Power&Energy Magazine*, 54-65.