TRANSNATIONAL ACCESS
USER PROJECT FACT SHEET

USER PROJECT	
Acronym	DSM-RSAMRE
Title	DSM and VC based Reliability and Stability Analysis of Microgrid with Renewable Energy
ERIGrid Reference	**03.002-2017**
TA Call No.	**3**

HOST RESEARCH INFRASTRUCTURE			
Name	**Delft University of Technology**		
Country	**The Netherlands**		
Start date	**16/7/2018**	**Nº of Access days**	**20**
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1. USER PROJECT SUMMARY (objectives, set-up, methodology, approach, motivation)

1.1 Motivation: While using distributed generation (DG) systems, voltage regulation is likely to be affected by the rapid changes in the levels of the generation and intermitting natural of source. One of the most important situations seen in microgrids are voltage excursions, which comes from voltage drops or voltage rises. The reason of this situation is disconnection or reconnection to the microgrid of DG's. To increase the reliability and stability of microgrid is also crucial to reduce voltage excursion when a DG reconnected to microgrid. Voltage control methods usually implemented as local solutions, with locally obtained measurements are used (e.g., power factor control or Q (V) Droop control of Inverters, voltage regulators, capacitor banks, etc.). As the distribution networks become more complex, more coordinated voltage control approaches, novel technologies, such as storage systems, information and communication technologies (ICT), advanced controls, etc. are used. In this way, DG penetration ratio are increased by distribution networks that effectively monitored and controlled.

1.2. Objective: The purpose of this project was to develop a coordinated voltage control method which ensures the voltage stability of a microgrid that contain wind and solar power systems. The microgrid model was installed in real time digital simulator system. Simulation model was controlled by fuzzy logic-based controller. Designed fuzzy logic-based voltage control system increased the voltage stability of the network system. Simulation results were obtained for different load and DG conditions and results were compared with uncontrolled system. Additionally, this project helps to develop their real time digital simulation software and hardware experiences of users.

1.3. Methodology and Approach:

This project aims to develop a coordinated voltage control method that will ensure the voltage stability of a microgrid which contain wind and solar power systems. For this purpose, a microgrid modelled in real time digital simulator system software (RSCAD) and fuzzy logic based controller modelled in Matlab/Simulink were used. Matlab/Simulink and RSCAD software had online communication system. Fuzzy logic based controller had three outputs and these were on load tap changer (OLTC), power factor control and power curtailment control of DGs. Designed fuzzy logic-based voltage control system decided which control method was appropriate for the system before controlling it. Control signals were transmitted to OLTC system of main transformer, PV and Wind distributed generation systems by fuzzy logic controller. Thus, voltage of microgrid was controlled and stabilised by fuzzy logic-based controller. The simulation results obtained different load and DG power cases.

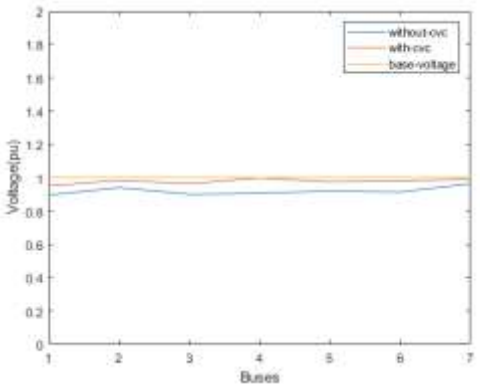
1.4. Test Set-up: In this project, a microgrid model that consists of seven buses system, a wind power system, a PV power system, an OLTC (On Load Tap Changer) controlled main power transformer and different loads was installed in real time digital simulation software (RSCAD). The control algorithm was implemented in Matlab/Simulink. The RSCAD and Matlab/Simulink communicated each other for data transfer by help of GTNETx2 board via TCP/IP protocol. All of

the buses' voltages were measured by phasor measurement units (PMU) and this data were transferred to MATLAB/Simulink software. The FLC that was modelled in Matlab/Simulink used these data and produced control outputs. These control outputs were transferred to RSCAD at the real time by TCP/IP protocol.

2. MAIN ACHIEVEMENTS (results, conclusions, lessons learned)

The objective of the implementation of the fuzzy logic coordinated voltage control is to control the voltage at the load buses within its permissible limits. The performance of the control algorithm investigated voltage excursion of buses under various buses voltages and DGs's output power conditions. The conditions are listed as below:

1) Low voltage, low power
2) Low voltage, medium power
3) Low voltage, high power
4) Medium voltage, low power
5) Medium voltage, medium power
6) Medium voltage, high power
7) High voltage, low power
8) High voltage, medium power
9) High voltage, high power
10) Very high voltage, low power
11) Very high voltage, medium power
12) Very high voltage, high power



For each condition buses voltage recorded with and without controller. In each case recorded quantities were plotted and compared with base voltage case.

The results showed that under different operating conditions, the buses voltage were still able to be kept within its allowable limits of not more than 1.05p.u. by the coordinated voltage control. In addition, without using the fuzzy logic coordinated voltage control, the voltages at the buses were mostly outside the allowable maximum limit of 1.05p.u. By utilizing the fuzzy logic coordinated voltage control, the desired output voltage range of less than 1.05p.u were managed to be achieved.

3. PLANNED DISSEMINATION OF RESULTS (journals, conferences, others)

It is planned to submit one paper for conference. It will be submitted to "2019 IEEE PES Innovative Smart Grid Technologies Conference Europe (ISGT-Europe)".