# TRANSNATIONAL ACCESS
# USER PROJECT FACT SHEET

| USER PROJECT | |
|---|---|
| **Acronym** | PV Systems |
| **Title** | To Investigate the Impact of Cumulative Penetration of PV Systems into the Distributed Network |
| **ERIGrid Reference** | 04.023-2018 |
| **TA Call No.** | 4 |

| HOST RESEARCH INFRASTRUCTURE | | | |
|---|---|---|---|
| **Name** | ICCS-NTUA | | |
| **Country** | Greece | | |
| **Start date** | 12 Jan 2020 | Nº of Access days | 15 |
| **End date** | 1 Feb 2020 | Nº of Stay days | 20 |

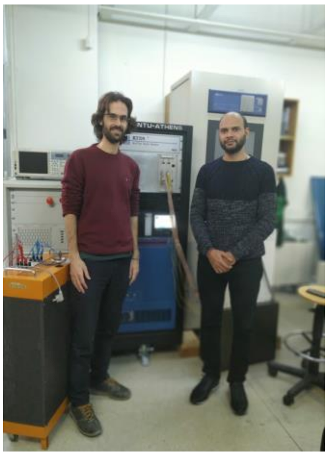
| USER GROUP | |
|---|---|
| **Name (Leader)** | Mr. Arvind Sharma, PhD Fellow |
| **Organization (Leader)** | University of Agder |
| **Country (Leader)** | Norway |

## 1. USER PROJECT SUMMARY (objectives, set-up, methodology, approach, motivation)

The goal of this work is to analyse issues / challenges related to high PV penetration and to implement the Q(V) droop control strategy to mitigate voltage fluctuation problems. The key objectives of the proposed work were to:

- Analyse the impact of high PV penetration within the medium voltage network and implement the droop control strategy to mitigate the voltage fluctuations, using the Real Time Digital Simulator (RTDS).
- Design and develop Power Hardware-in-Loop (PHIL) configurations to test a hardware PV inverter and implement the droop characteristics to address the voltage fluctuation problems.

In the first experiment, RTDS system and RSCAD software are used for analysing the impacts of PV system penetration into the distribution network. In the second experiment, the Power Hardware-in-the-Loop (PHIL) method is used in which a real hardware PV inverter is connected to the RTDS. The CIGRE medium voltage network is studied, where different grid topologies are created (by closing switches) and the impact of the topological changes is analysed. Voltages, line loading, transformer loading, active and reactive power of the inverter and power flow at each line are monitored. Part of the testing infrastructure of ICCS-NTUA, Athens is shown below.




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

This work showed that connecting both feeders through switch $S_1$, makes significant improvement in the voltage profiles within the MV network, however in the other grid topologies when switches $S_2$ and $S_3$ are closed, the improvement is not significant. A comparison of with and without Q(V) droop control strategy during the PHIL experiment is shown in Figures 1 and 2 respectively. In Figure 2, the maximum bus voltage is reduced from 1.09 to 1.04 p.u. It is also observed that closing switch $S_1$ and connecting both feeders together, may be useful for balancing the transformer loadings of TL1 and TL2.

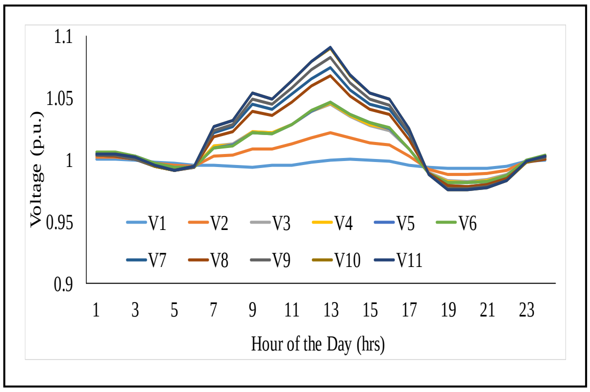



Fig 1: Bus voltages without Q(V) droop (PHIL test)

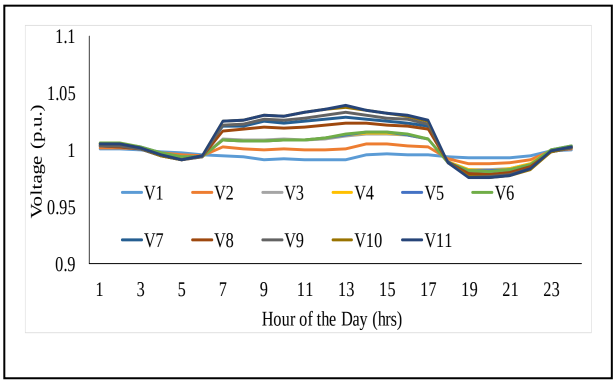



Fig 2: Bus voltages with Q(V) droop (PHIL test)

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

Based on the results obtained from the experiment work, a research publication is being prepared for an international conference or a DBH approved/ peer reviewed journal.