EFFICIENT INTEGRATION OF ELECTRIC VEHICLES THROUGH OPTIMAL COORDINATED CHARGING AND REACTIVE POWER SUPPORT

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Introduction

The EU has set a goal to have at least 30 million zero-emission vehicles on the road by 2030, in order to reduce greenhouse gas emissions and improve air quality. This additional load could potentially lead to network operational problems due to larger voltage drops and grid congestions in peak hours accompanied by high EV charging patterns. In addition to EV smart charging which is primarily focused on controlling active power consumed by EVs, utilization of EVs for reactive power support could additionally increase network EV hosting capacity. This paper describes a method for the efficient integration of electric vehicles through optimal charging and reactive power support.

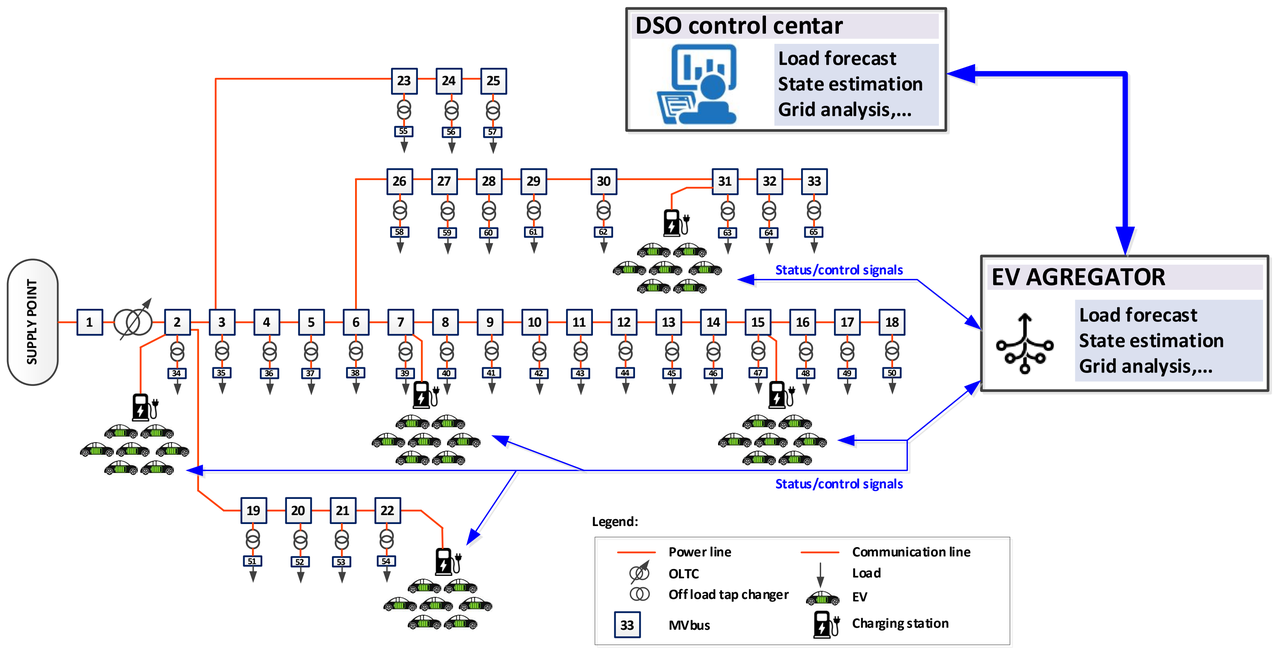

Figure 1 – Modified IEEE 33bus network with EVCS

Case study

CASE 1: Smart charging – in this case charging process is managed and optimized by a central control system in a way that only controls active power consumption.

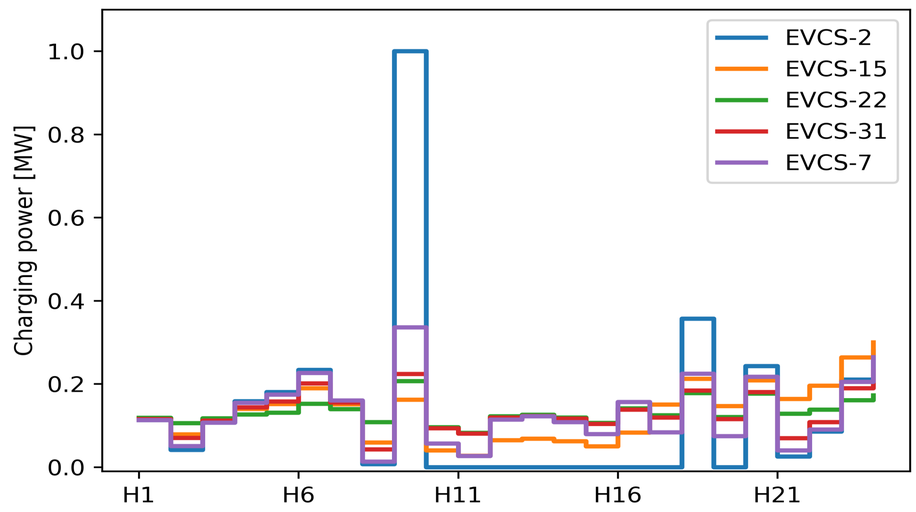

Figure 2 – Optimal charging profiles for Case 1

Figure 4 – Voltage profile for different charging control strategies

CASE 2: Smart charging + EV reactive power support – in addition to smart charging uses EV reactive power support to manage network conditions

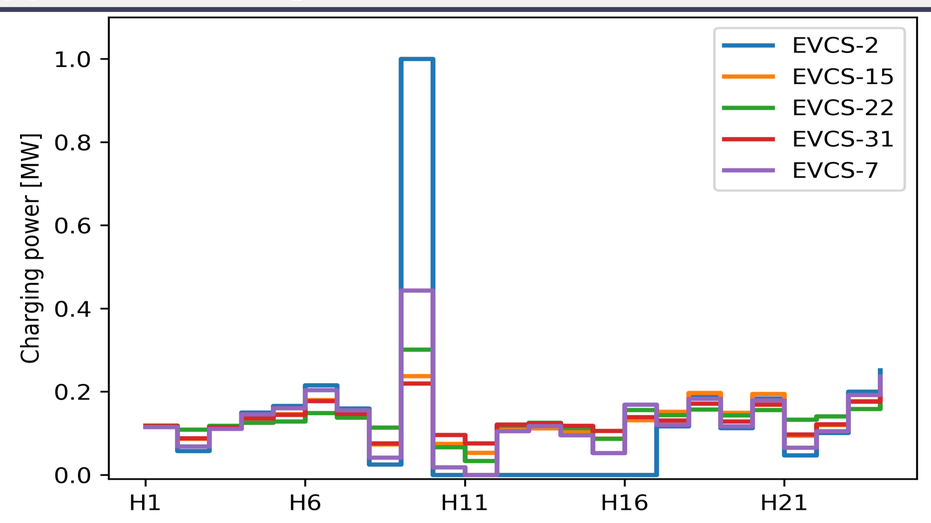

Figure 3 – Optimal charging profiles for Case 2

Figure 5 – Comparison of EV energy requirement charging curtailment

Conclusion

The proposed control logic can help to improve the distribution network operating conditions, extend EV charging capabilities of the existing grid, and reduce the costs associated with traditional methods of providing reactive power support. Reactive power support from EVs represent still a relatively new field of research and technology, and not all EVs are currently able to provide this kind of support.

This work was funded by the European Union through the European Regional Development Fund Operational Programme Competitiveness and Cohesion 2014–2020 of the Republic of Croatia under project KK.01.2.1.02.0228.