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Virtual Power Plants and Large Scale Renewable Integration New Mexico Regional Energy Storage and Grid Integration Workshop, 24 Aug 2016

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Virtual Power Plants



- VPPs are aggregations of DER assets controlled to provide identical (or superior) grid-support services compared to traditional generators.
 - Enables renewable energy, demand response, and energy storage to provide grid services
 - Improves grid reliability by providing additional operating reserves to utilities and ISO/RTOs
 - Removing renewable energy high-penetration barriers
- Goal: Develop a unified platform incorporating <u>resource forecasting</u>, standard <u>communications</u>, <u>optimization</u>, and <u>control/dispatch</u> to provide grid services with DERs.

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Virtual power plant with communication network (EPRI)



Lake Side natural gas turbine power station in Vineyard, Utah. (Wikipedia Commons)

VPPs will provide a range of grid services







VPP Architecture

 Depending on the ancillary service(s) and the market, the VPP architecture and execution vary. Generally, there are 4 steps:



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DETL-MdS-Prosperity VPP Use Case

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Albuquerque Airport

Kirtland Air Force Base







Mesa del Sol



Aperture Center



PNM Prosperity Project

VPP Forecasting





Day-ahead Unit Commitment Co-optimization





Optimization

 Example of the optimization shifting solar energy to higher price point





Battery

discharge at

Controls





Red Team Demonstrations at DETL



Goal: protect the VPP through enclaving of VPP DERs and intrusion detection algorithms.

Conclusions



- Sandia development of Secure Virtual Power Plants will:
 - Increase the quantity of renewable energy on the grid
 - Improve the electric grid resiliency in high-penetration solar situations
- Sandia is researching different aspects of VPP technology:
 - Stochastic optimization
 - Advanced coordinated DER controls
 - Secure communications and cybersecurity
 - DER interoperability
- Conducting demonstrations at Sandia in 2017 with real hardware!



Questions?

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