Notes on the IEEE 13 Bus OpenDSS Model supplied by Open Energy Solutions

Along with an overview of the expectations conveyed by Avista for the *actual* use-case.

Fore note:

In terms of the nature and penetration of GED, the features of the sent OpenDSS model and what I was told in my last meeting by Avista didn't quite match. In the following points, if the features of the grid described by Avista (Ben Shannon) conflict with those found in the OpenDSS model, I'm specifying the features discussed in the meeting. Still, I'm attaching my writeup for the supplied OpenDSS model at the end.

Details of the *actual system* as discussed in the meeting

Electrical Model of the Grid: Three-phase unbalanced* Distribution System

Linear/Non-Linear? : Unsure. (Current development is for a Non-linear model)

*expected to be unbalanced (but not with certainty). Current algorithm design for Balanced three-phase is fine.

Horizon Interval and a single time-period interval: $T = 24h, \ \Delta t = 1h$ (Day-ahead hourly optimization)

PV Penetration: Between very low (1% of demand) to none. A number I was given was a mere $500kW$ PV for $60MW$ of demand power.

Storage Penetration:

- Low (5% of demand).
- In terms of number of nodes where batteries are present, a total of 5 batteries (1 utility-scale storage and 4 Edo-nodes) should be more than enough.
- 1 Edo node per area *seems fine*.
- Types of batteries: Two Types of Batteries:
    - Edo-nodes: Batteries WITHOUT reactive power control
    - Utility-scale storage: Batteries WITH reactive power control

Details of the modified IEEE 13 Bus OpenDSS Model

Added here for the sake of completeness, even if some details conflict with the meeting discussion. This was written before the meeting, and assuming that the model correctly represents the *actual system*.

Summary:

The model's base topology is the same as the IEEE 13 bus system (Unbalanced three-phase), with 3 PV modules added to 3 nodes, and 1 ESS added to one of them. There are two other fixed generation DERs too.

Nature of Grid Edge Devices:

The grid edge devices component-wise look the same as what I've already modelled (with PVs still essentially being a time-series of Real Powers, though modelled using multiple time-series including Efficiency, Irradiance, Temperature). Battery is modelled on similar lines as my own, with Initial SoC, Rated SoC, Rated Discharging/Charging Powers and efficiencies.

<u>What do I require to model it?</u>

Experience with modelling three-phase unbalanced OPF problems. (So far I've only been modelling Balanced Three-phase OPF.)