TAP Resource Adequacy and Modeling Subgroup
3/10/2022

This feedback to HECO is based on HECO's slides and presentation on 3/10/2022. The presentation aims to provide a walkthrough of the commission order and how it relates to RA.

As with all TAP feedback, please consider these comments as recommendations – the final choices are yours of course. And some of these topics are quite complex, so the few sentences included here just scratch the surface and hopefully point in a direction we think might be helpful.

TAP Members:
Andy Hoke (NREL)
Aidan Tuohy (EPRI)
Derek Stenclik (Telos)
Matthias Fripp (Univ. of Hawaii)
Elaine Hale (NREL)
Gord Stephen (NREL)
Jo Ann Rañola (EPRI)

Other participants on the call
Marc Asano (HECO)
Ken Aramaki
Collin Au
Leland Cockcroft
Riley Fukuji
Daniel Lum
Isaac Lum
Christopher Kinoshita
Dean Oshiro (HECO)
Abel Siu Ho
Kenton Suzuki
Robert Uyeunten (HECO)

Presenter:
Christopher Lau (HECO)

Sub-committee chair summary, Aidan Tuohy:
The TAP sub-group on reseource adequacy have had several recent interactions with HECO staff on their proposed methods. The general agreement coming out of the recent call was that the stochastic modeling proposed is a good approach that incorporates recent feedback, with discussion and debate focused on specific aspects like number of samples needed for both weather years and outage rates. The calibration factor may need further details in future discussions, and the TAP would suggest to continue exploring PLEXOS capabilities for adequacy modeling.

New metrics, or combinations of existing metrics, could be examined further, for example EUE, and HECO should also work to identify the best way to set criteria; for this iteration, basing it on the calibration modeling is appropriate, but this is something industry in general is revisiting – see for example EPRI's ongoing RA initiative. Once recommendations are made there, HECO should review and determine their applicability to the Hawaiian system.

In general, the TAP suggested follow up topics to allow HECO to continue to refine the work, with the overall approach being reasonable and justified for the first IGP cycle. As results come in, some minor tweaks may be needed, but the approach is in line with practices used elsewhere. HECO have done a good job of gathering input from the TAP, researching the topic and coming up with a proposal that provides additional modeling detail needed to address adequacy issues.

TAP feedback and comments are divided into three categories:

1. Informational, no action needed
2. Action required, expected in coming months
3. Concern or suggestion, for future discussion or consideration
4. Clarification needed

TAP Comments During the Meeting and HECO Responses

Sample size

- Number of samples –
    - 250 is a reasonable start – especially if the change on the system is large (ie. Comparing a 2030 resource mix to today's resource mix). If you are trying to compare a small change, like determining the capacity credit of an individual resource, then more samples is likely more important (Derek).
    - Model simplification and parallelization using PLEXOS connect can help reduce runtimes and allow for more samples.
    - For each weather year, unique outage draws for each sample (Derek) For example, if you ran 5 weather samples against 50 unique outage draws, the total number of outage draws would be 250 unique outages (this is how PLEXOS stochastics is setup by default). While this would not let you compare weather years in an apples-to-apples fashion, it increases the total number of outage samples.
    - In near term, outage draws are more important, in the future may need to think about additional weather years. Ideally you would have 20 or more years of correlated wind, solar, and load data – but that is likely a task for the next planning cycle (Derek)

    - Check standard error and ensure its small enough (Gord)
- Are you simplifying the model to allow to run more than 250 samples (integer, etc.) (Gord)
    - **Derek can provide ideas for speeding up PLEXOS. In general for the probabilistic resource adequacy assessments, the model can be run in "Linear" fashion for the ST module. In addition, you can remove the following properties: min up/min down times, ramp rates, minimum stable levels, transmission. Each of these can be evaluated, but it is a trade off between runtime and precision.
    - In addition, PLEXOS now offers PLEXOS Connect to run cases across multiple computers. You can split by stochastic sample to allow a single license to run multiple samples in parallel. This improves runtime specifically.
    - We have also noticed that writing outputs to the solution increases runtime a lot in stochastic runs. Simplifying the PLEXOS reporting to include only ones required for unserved energy calculations can help a lot.
- Clustering
    - Weather data – cluster samples (Matthias) by types of day
    - Outage data – look at using clustering approach to determine how often you are down a certain amount of MW – then you can weight draws if having same type of outage event (e.g. a given likely event may have 10% weight, less likely may also be able to be examined) (Matthias)
    - Similar thought process as day weighting but applied to outages - Don't need to model all plants if they have similar profiles - Do many more draws and then cluster
    - **HECO to follow up with Matthias
    - PLEXOS has the functionality to reduce the outage sample draws *prior to* the hourly simulations. I have not used this functionality, but it should do something similar to the sampling that Matthias was referring to. Here is the excerpt from the manual. (Derek)

      "Stochastic Reduced Outage Pattern Count invokes the Sample Reduction Algorithm on the pool of Outage Pattern Count outage draws, reducing the number of samples iterated through in the Monte Carlo simulation.

      The default value of zero means that no reduction will occur i.e. all Outage Pattern Count draws are simulated. Any number that is at least one but less than Outage Pattern Count will cause the algorithm to reduce the samples after sampling and before simulation. Reducing the 'raw' sample count will improve execution time and the reduction algorithm aims to reduce the samples simulated with minimal effect on the accuracy of the results."
    - Maybe use PLEXOS to simulate distributions and then can do the analysis (Jo Ann)
        - I would not go this route using the PASA outputs and manually selecting. While it could reduce computational time, it will significantly increase the manual time and potentially prone to bias or errors. (Derek)
        - Writing the outage ratings as part of the full ST simulation could significantly increase the runtime. I would suggest writing the outage ratings as part of model QA (quality assurance). Suggested steps are: (1) Assign a random number seed to the model, (2) Enable writing of outage files in PASA, (3) Remove ST

Schedule in the simulation and only keep PASA, (4) Run the model, and (5) Analyze the distribution of outages across all samples. Using these steps, the outages drawn from PASA can be analyzed separately without affecting the full ST simulation runtime. (Jo Ann)

- Calibration factor – just running one year to identify lost load hours in previous year
    - Calibrated to actual operations – is this the best way to set criteria?
    - It was unclear from the discussion if using the Calibration factor modeling runs would include stochastics and multiple outage draws/weather years. In general it should if it is being used to assign a criteria for a probabilistic value. (Derek)
- Metrics for RA
    - Normalized EUE against annual load parts per million (Gord) (maybe as 99.99 rather than 0.001)
    - LOLE (days/year), LOLEv (events/year), LOLH (hours per year), EUE (MWh/year) (Derek)
    - Heat maps (Aidan)
        - Size of shortfalls, Max Power shortfall (MW) in rows, Total Energy shortfall (MWh) in columns.
        - Timing of shortfalls, months in columns, hour of day in rows, showing the proportion of LOLH or EUE
    - Output during outage times (Matthias – HECO to link back)
    - Aidan to send EPRI metrics document once available
- Reporting
    - No real way for PLEXOS to report, have to do it outside
        - Correct, we can share some excel formulas and help with python code to develop RA metrics – both aggregate or for individual metrics. Reporting can be done on hourly or daily unserved energy (MWh) or unserved energy hours (hrs) (Derek)
        - This is somewhat manual, but it allows for very detailed report summaries (Derek).
        - Be careful on other reports being written, as this could slow down runtimes and increase file sizes significantly. I recommend running with a lot of reporting completed for each weather year (i.e. generator available capacity, generation, etc., but then reducing reporting for full stochastic samples) (Derek).
        - Extracting data from PLEXOS solution files and converting them into a format required in an R or python code that calculates the RA metrics is a faster approach. (Jo Ann)
    - For percentiles – average is normally used. Belgium uses 95th percentile and may want to look at CVAR
- What are 'firm' renewables?
    - Considering those with a fuel source
    - Are power to fuels being considered?
    - Think about whether there is a potential challenge later for getting more solar on
    - HNEI+Telos just completed some analysis on the need for firm capacity at very high penetrations of VRE. We developed a simplified methodology to calculate the need, and then tested this methodology against more detailed probabilistic resource adequacy

runs and were surprised by the results. We found that the system still needed ~600 MW of firm capacity (i.e. capacity that did not have fuel supply constraints and could operate for multiple days) in a 70-90% VRE scenario. We can setup time to share some of this work if that is of interest (Derek)
    - May want to look at long duration storage (will issue RFI)
- Other
    - The presentation shared with the TAP members included a comment on using the PLEXOS PASA to calculate reliability indices. I would not use these values as they do not account for the hour-to-hour dispatch scheduled for energy storage so you will be missing the granularity available in the ST. PASA should only be used for the scheduling of outages, not calculation of reliability indices in a system like Hawaii (Derek)
    - Derek has a good point on using PASA for the calculation of reliability indices. While the calculation from PASA is based on the convolution approach, it does not take into account the detailed parameters that impact RA. Calculation of reliability indices from ST simulations is recommended over using PASA. (Jo Ann)