Reserve Requirement Study (RRS) and Effective Load Carrying Capability (ELCC)

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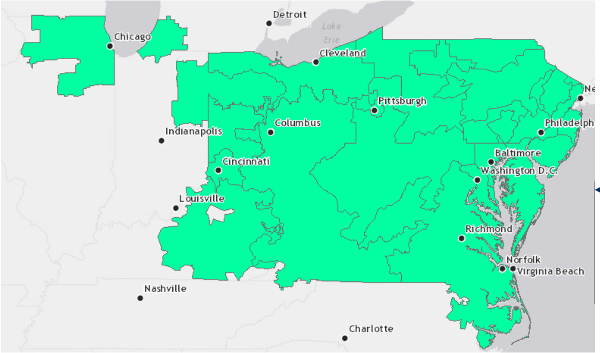
Reserve Requirement Study (RRS)

- Objective
  - Compute Installed Reserve Margin (IRM) and Forecast Pool Requirement (FPR)
  - FPR then is used to construct a downward sloping demand curve in Reliability Pricing Model (RPM)
- Approach



PJM

Capacity Benefit Margin (CBM)

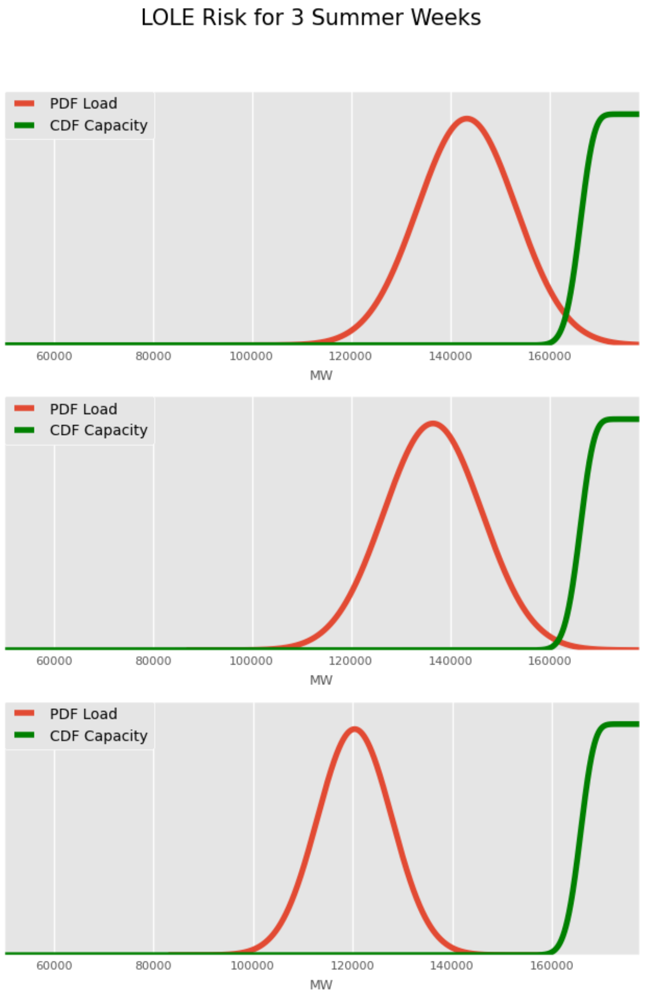
MISO
NYISO
TVA
VACAR

World

Reserve Requirement Study (RRS)

- Inputs (for PJM and World)
  - Generation
    - Expected Generation fleet (capturing expected additions, retirements)
    - Forced Outage Rates (EFORd)
      - Rate assumed to provide the probability that a unit is unavailable on a forced outage at the time of demand
    - Planned Outage Requirement
      - Deterministic amount of weeks (schedule is optimized to levelize reserves)
  - Load
    - Profile throughout the year (e.g. monthly/weekly/weekday peaks)
      - From the PJM load forecast (which assumes 50/50 weather)
    - Statistical distribution for weekday peaks
      - Normally distributed (captures uncertainty in weather/economics)
      - Parameters of distribution obtained from historical loads

Reserve Requirement Study (RRS)



The same comparison is made for the remaining
49 weeks of the target year.

Study criteria: total annual LOLE = 0.1 events/yr.

In other words, LOLE = $\sum_{year} E(X < Y) = 0.1$

Reserve Requirement Study (RRS)

- Output
  - Installed Reserve Margin (IRM) = Total Installed Generation / Solved Annual Peak Load
    - IRM is a percent value (e.g. 15%)
  - Forecast Pool Requirement (FPR) = (1 + IRM) * (1-Average Forced Outage Rate)
- The IRM is the required capacity in ICAP terms
- The FPR is the required capacity in UCAP terms

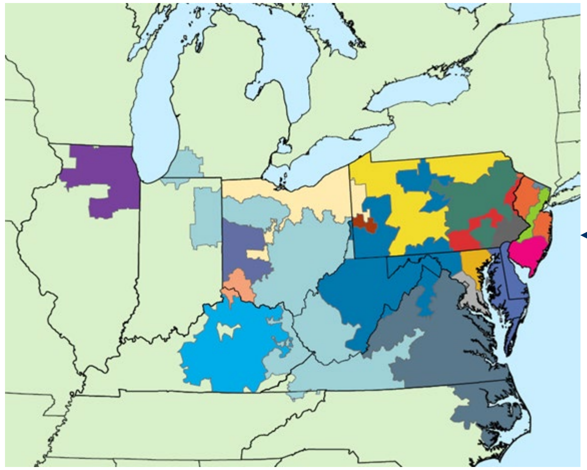
If the IRM increases only due to a higher fleet-wide Average Forced Outage Rate, then the FPR remains constant

Capacity Emergency Transfer Objective (CETO)

- Similar to the RRS
  - But applied to Locational Deliverability Area (LDA)
- Objective
  - Compute CETO for each LDA (i.e., amount of imports needed) which then is compared to the Capacity Emergency Transfer Limit (CETL)
  - Also, total amount or resources (including CETO) is then used to calculate the reliability requirement of an LDA

Capacity Emergency Transfer Objective (CETO)

- Approach



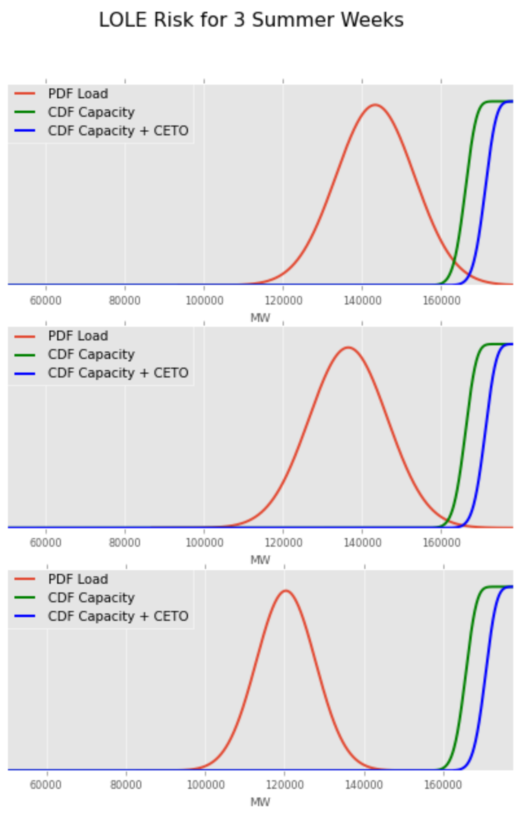
LDA

Other LDAs (inside PJM) and/or neighboring World regions

Capacity Emergency Transfer Objective (CETO)

- Inputs
  - LDA’s Internal Resources and Load (similar to RRS)
- Criterion

Annual LOLE = 0.04 events/yr.



Capacity Emergency Transfer Objective (CETO)

- Output
  - CETO
  - Reliability Requirement (RR) = CETO + Total Internal UCAP
    - Used in RPM

Observations about RRS and CETO

- The calculation of reliability requirement performed in the RRS and CETO studies is meant to address the following question
  - What is the amount of UCAP PJM (or an LDA) required to address (mainly) load uncertainty?
- Though the RRS and CETO analyses are performed separately, they should be seen as one large resource adequacy study

RRS and CETO in RPM

- So far we have reviewed the reliability requirements for PJM and the LDAs based on the RRS and the CETO studies
- Those requirements are in Unforced Capacity (UCAP) terms
  - Recall the multiplication by (1-Average Forced Outage Rate) in the FPR and RR computations
- In RPM, each resource that is eligible to compete has a UCAP valuation
  - And they compete to meet the UCAP requirement as defined by the VRR curve
- UCAP valuation is what we refer to as Capacity Capability (or Capacity Value)

ELCC and RRS

- As described in the previous CCSTF meeting, ELCC is a method to calculate the capacity capability of resources
  - The ELCC result is largely determined by the performance of resources during hours with LOLE risk
- Both ELCC and RRS studies are therefore LOLE studies

Interaction between ELCC and RRS

- In general, the ELCC case includes two runs:

Base Run (excluding resources of interest) – Meets 0.1 events/year criteria

Final Run (includes resources of interest) – Meets 0.1 events/year criteria

- The Base Run above should be consistent with the RRS case
  - As part of the 2020 RRS assumptions, PJM is taking the step to remove wind and solar from the RRS so that the resource fleet is consistent in the ELCC Base Run and RRS
  - PJM recognizes that the ELCC runs above are hourly while the RRS runs are based on the daily peaks. However, this is not an issue as the Base Run excludes resources that have limitations (such resources would have demanded hourly modeling)
  - The Base Run ELCC and the RRS both have an LOLE of 0.1 events/year

- If the Base Run in the ELCC process is established so that it is consistent with the RRS, then **the calculated ELCC values for the resources of interest (intermittent, limited) are consistent with the FPR calculated in the RRS**
  - For instance, let's assume that the FPR in the RRS (ELCC's Base Run) is 1.0860. This is the result of having 162,900 MW of UCAP and a peak load of 150,000 MW

    FPR = 162,900 MW / 150,000 MW = 1.0860
  - Let's say we are interested in calculating the ELCC of a 500 MW nameplate resource that every day produces 100 MW from 8 AM to 8 PM

Interaction between ELCC and RRS

- The Final Run will produce an ELCC of 100 MW for the resource. If we were to look at the peak load of the Final Run, this will be higher than the one from the Base Run. In fact, it will be approximately 150,090 MW
- What if we compute the FPR with the values from the Final Run. Let’s call it FPR’
  - FPR’ = (162,900 MW + ELCC of Resource) / 150,090 MW

    = (162,900 MW + 100 MW) / 150,090 MW

    ~ 1.0860
- In other words, the capacity value resulting from the ELCC run is such that it is consistent with the FPR value calculated in the Base Run (which happens to be the FPR calculated by the RRS)