Review of PJM Modeled LOLE AI-181-1.2

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Background

- The question was raised concerning whether PJM should be modeled at its 2016 LOLE value or the nominal criteria value of 0.1 days per year.
- Action item 180-4 later 181-1.2 entitled: “Review the PJM LOLE 0.14” was established to track this question.
- Review of historical data from 2009 forward, shows the LOLE value modeled for PJM has ranged form the 2016 value of 0.147 to a high of 0.686 and a IRM value that ranges from a high of 19.2% or a low of 7.4%.
- The modeled PJM LOLE value averaged 0.345 while the IRM averaged 13.8% over this period.

Background (continued)

- Generally, external areas have been modeled less reliability or more conservatively than NY because the level of detail such as zones and transmission transfer capability were not modeled in the external areas.
- As such modeling detail was included in the external areas the amount of residual uncertainty[(1)] was reduced and the LOLEs of external areas were modeled less conservatively.
- Another driver of applying some level of conservatism in modeling assumptions is that the preponderance of the available research regarding the nature of the total system costs profile as a function of the reserve capacity margin has shown it is preferable to be on the higher reliability end of the minimum portion of the curve rather than on the lower end [(2)].
- I.E., the costs associated with having additional reserves above the minimum required is considerably smaller than not having enough reserves.

Basis For A Target PJM LOLE of 0.14

- The basis for the 0.14 was a presentation presented by PJM at the IEEE Power Engineering Society General Meeting July 2015 in Denver
- The presentation was entitled: “Probabilistic Methods in Resource Adequacy Planning at PJM”
- PJM conducts three key probabilistic adequacy studies:
  - Installed Reserve Margin Study which is based on 0.1 LOLE criterion
  - Capacity Emergency Transfer Objective (CETO) which is based on a 0.04 LOLE criterion and is the LOLE Risk due to Transmission
  - Demand Response (DR) Caps
- The end result is a total LOLE that encompasses both generation and transmission adequacy

Zone	CETL (MW)	Capacity Adequacy LOLE Risk (events/year)	Transmission LOLE Risk (events/year)	Total LOLE Risk (events/year)
LDA X	CETO	0.1	0.04	0.14
LDA Y	> CETO	0.1	< 0.04	< 0.14

Basis For A Target PJM LOLE of 0.14 (continued)

- The CETO/CETL analysis is conducted for 25 Locational Delivery Areas (LDAs) or zones.
- Each LDA is evaluated with respect to its neighboring LDA using a two area analytical model.
- CETO is the amount of imports that a zone will need to meet the LOLE criterion of 0.04.
- The CETO is compared to the capacity emergency transfer limit (CETL) to determine if enough transmission capability is available to satisfy the CETO.
- If CETO equals the CETL the total loss of load for the zone will be .14
- If CETO less than CETL the total loss of load for the zone will be < .14

Governing Resource Adequacy Criterion for PJM

- PJM is a member of the Reliability First Corporation which encompasses the footprints of the PJM RTO and the MISO.
- Standard BAL-502-RFC-02 defines entitled: Planning Resource Adequacy Analysis, Assessment and Documentation which establishes common criteria, based on “one day in ten year” loss of Load expectation principles, for the analysis, assessment and documentation of Resource Adequacy
- Include the following subject matter and documentation of its use:
  - Load forecast characteristics
  - Resource characteristics
  - Transmission limitations that prevent the delivery of generation reserves
  - Assistance from other interconnected systems including multi-area assessment considering Transmission limitations into the study area

Resource Adequacy Criterion (continued)

- With respect to transmission limitations that prevent the delivery of generation reserves PJM states that only deliverable capacity is included in the analysis.
- The determination of the IRM is based on the assumption that the delivery of energy from the aggregate of available capacity resources to load (load deliverability) within the PJM footprint will not be limited by transmission capability.
- For load deliverability, PJM states that the transmission system is tested at a LOLE of 1/25 so that the transmission risk does not appreciably diminish the overall target of a 1/10 LOLE for PJM.
- There is second deliverability test, the deliverability of generation that test the ability of an electrical area to export capacity resources to the remainder of PJM and is a deterministic n-1 type analysis.
- This test is used in the RTEP process to determine if a proposed generation interconnection qualifies as ICAP and whether the particular generator being tested qualifies to be included in the IRM study.

Findings

- PJM has identified locational delivery areas (LDAs) that may exhibit a composite LOLE for resource and transmission adequacy as high as 0.14 for those cases where CETO equals CETL.
- An Areas' LOLE can not be better than any of its subareas.
- This transmission adequacy risk between LDAs (25 sub areas) implies a level of a residual uncertainty remains even with an expanded more detailed model of PJM.
- Other residual uncertainties remaining in PJM are as follows:
  - Modeling variable generation as derated perfect capacity – risk of EA being supplied from these units during hours where it would not be unable to be supplied.
  - The PJM RTO is not contiguous with areas in Michigan and Illinois that are not directly connected with the other systems comprising PJM – risk of excess capacity in those areas not being available to supply EA.

Recommendation

- Given the number of residual uncertainties that remain in PJM and that PJM has stated that there are potentially LDAs that have composite LOLEs of 0.14, it is recommended that the target LOLE for PJM be maintained at 0.14 for the 2017 IRM study.

Footnotes

1) Courtney, Kirkland & Viguerie in 1997 defined residual uncertainty as the uncertainty that remains after the best possible analysis has been done. It has also been defined as exposure to loss remaining after other known risk have been countered, factored in, or eliminated.
2) See Dr. Kelvin Chu and Dr. Roy Billinton response to Rich Felak's letter to the editor entitled: "The Proper LOLP" on page 18 of Volume 14, Number 1, January/February 2016 issue of the IEEE Power & Energy Magazine