Probabilistic Reliability Planning Project

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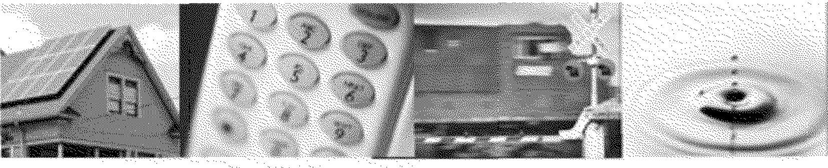
California Public Utilities Commission



Overview of presentation

- Objective and Summary
- Brief intro - probabilistic reliability modeling
- Coordination effort
- Possible uses for the model
- Next Steps

Current status and project objectives

Where we are so far

- Energy Division has procured software from vendor, installed software, and are creating base case to model
- Four year license for the SERVM model from Astrape Consulting
- Energy Division is preparing database and training staff to support probabilistic reliability modeling

Project objectives

- Move from deterministic analysis to probabilistic analysis for LTPP and resource "need"
- Develop Effective Load Carrying Capability (ELCC) studies for wind/ solar resources – provide better quantification of capacity value relative to reduced system risk
- Compare and validate stakeholder studies (CAISO, SCE, etc.) and provide better analysis to the Commission

What is probabilistic reliability modeling? What is ELCC?

Brief intro - probabilistic reliability modeling – Loss of Load or Expected Unserved Energy

- Somewhat specialized field, lots of jargon
- Contrasting probabilistic with deterministic analysis – finding likely range of outcomes, not just most extreme or impactful
- Probabilistic modeling – statistical modeling relying on multiple iterations with multiple “draws” of certain stochastic variables
- Model a year one hour at a time, then model it again hundreds of times, total results and divide by number of iterations –expected value
- Allow for a study of the marginal reliability impacts of certain resources (ELCC)
- System resource adequacy metrics:
  - Frequency is expressed as percentage risk - Loss of Load Expectation (LOLE)
  - Magnitude/duration MWh of expected outage - Expected Unserved Energy (EUE)

Brief intro - ELCC

- ELCC is a study of the reliability benefit provided by the "marginal" target addition of capacity (such as wind or solar resources, individually or as a group) compared to standard "perfect" capacity
- Iterative – model entire system without target resource, add target resource and model again, then calibrate by adding alternative resources until reliability metrics equalize
- ELCC is ratio of Translation – adding MW of target resources decrease reliability indices equal to the MW of alternative "perfect" capacity

Probabilistic versus deterministic

Deterministic analysis

- Input one value for each input
- Result of study is one value – generally most impactful or extreme case
- Can model exact scenario – specify each and every variable
- Find most extreme/most impactful result
- Example – CAISO annual Local Capacity study, Transmission Planning study

Probabilistic analysis

- Input range of values, or one value with uncertainty bars
- Result is expected range over range of inputs
- Model variability around values – impact of variation/uncertainty in analysis
- Find most likely range of results
- Example – Annual installed capacity benefit margin study in NYISO

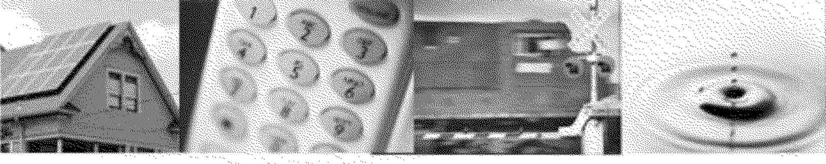
Common variables in probabilistic analysis

Common deterministic (unvarying) variables

1. Size/operating characteristics of conventional generators, planned outage schedules
2. Peak and energy demand totals for each month/year
3. Must take non-dispatchable generation – run of river hydro
4. Transmission ratings, MW capacity

Common stochastic (drawn from pool of values) variables

1. Forced outage rates/in service status of generators on hourly basis
2. Distribution of load shapes, weather
3. Intermittent non-dispatchable generation profiles – wind or solar facilities
4. Transmission outage rates



Applications of better analysis

Current processes

- Exceedence methodology for qualifying capacity – adopted in 2009
- Long term LTPP system analysis is deterministic, focused on peak, and unable to quantify uncertainty
- Energy Division produces analysis to support Commission action

Application for analysis

- Set QC via ELCC – mandated by SB 1x2 and in scope of R.11-10-032, proposal scheduled for Dec 2013
- LOLE analysis quantifies impact of variability of several variables at same time
- Energy Division staff is able to upgrade the quality of analysis and respond to inquiries faster.

Coordination

- Coordination with other state agencies
  - CAISO TPP and flexibility studies
  - CEC IEPR studies
- Coordination with other sections in Energy Division
  - LTPP long term planning scenarios
  - Demand Response program design and evaluation
  - Data coordination among multiple sections

Current status of database – projects to complete/upgrade data

- Key examples of current database is being developed
  - Development of hourly load shapes reflective of weather and split to areas of California
  - Development of hourly normalized load shapes for areas outside of California
  - Fully utilize GADS data to create individualized outage histories and unit specific outage information to use in modeling
  - Incorporate full range of data available for DR programs and program design – gauge variety of DR program designs, and reliability impacts of DR program designs
  - Quantify and understand diversity of hydro facilities
  - Production hourly profiles for wind and solar facilities for California and outside of California – quantify the correlations between weather and production for these facilities
  - Take advantage of as much existing analysis as possible

Next Steps

- Continue to train staff, develop base case
  - Lots of analysis going on – begin more regular phone calls with CAISO and CEC staff
  - Group of staff at CEC and CPUC are coordinating processes and inputs to perform some coordinated analysis (so far just training and getting ready, not producing reports yet)
  - Finalizing initial base case in September, begin modeling in October
  - Energy Division staff is preparing a proposal for how to calculate ELCC for wind and solar resources, and a proposal for study and analysis is scheduled for December 2013 pursuant to scoping memo in R.11-10-023
  - Continue to revise data and become more comfortable with probabilistic analysis.