Reliability of Electric Systems in the United States

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September 18, 2007
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Reserve Margin

- Reserve Margin-
  - The difference between the dependable capacity of an electric utility's system and the anticipated peak load for a specified period

The Need for Reserve Capacity

- Reserve capacity is needed in case of:
  - Failure of a generating unit in operation or of supplies to the system
  - Interruption of transmission service, or,
  - Customer demand in excess of generation plant capacity
- Reserve capacity may be obtained from spare generating units or through interconnection

Determination of Reserve Margin

"Planning for unreliability"

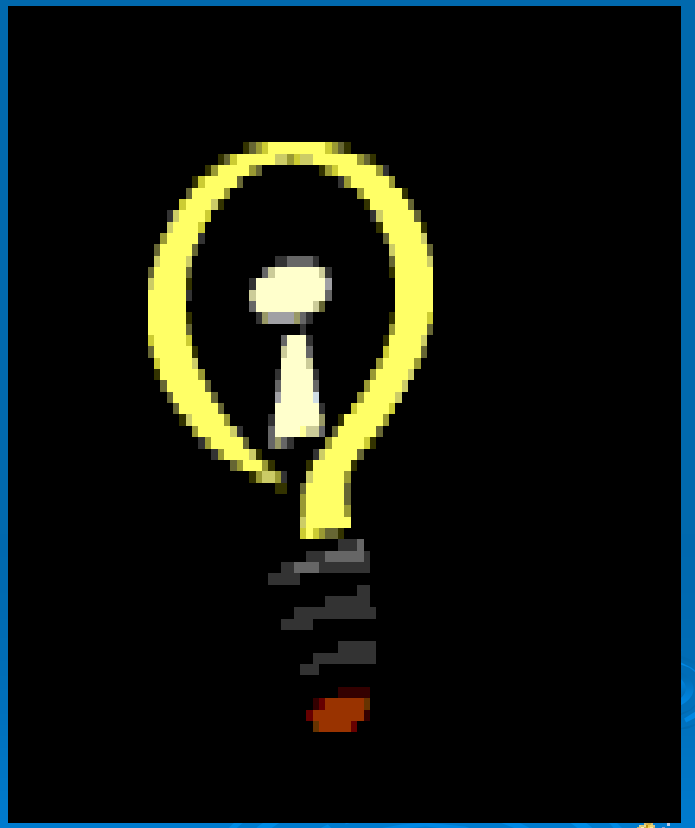
- Typically, 15% is the number associated with reserve margin
  - ConEd in New York, circa 1930, was the first utility to try to quantify the amount of extra capacity needed to assure a high degree of reliability. They retained a University of Missouri-Rolla professor. The best advice he could give was:
  - Have enough capacity in reserve to cover a situation where the utility's largest unit had to be taken out of service (a single contingency).
  - Multiply the peak demand by, pick a number, 1.15 to produce a reserve margin of 15%.
- These became the accepted industry practices and, to a large extent, are still accepted today.

“Planning for Unreliability”

- In the 1970s, a Pennsylvania utility was planning for several major additions to the company’s generating fleet.
  - In order to know how much generation to plan for, the system planner asked his management and board “how much unreliability should I plan for?” The story was that his management was aghast! No unreliability was acceptable.
  - The guy went back to the drawing board and agonized about how his company could afford so much generation redundancy so there would be no chance of having insufficient generation at any time.
  - He thought back to a period when everything seemed to go right and concluded that, during this period, the company had a probability of having insufficient generation 1 day in 10 years. Of course this, then, became the industry standard.

Selection of Reserve Margins

- Selection of a Reserve Margin is not an exact science
  - Statistically, the probability that there would be insufficient capacity at any moment in time is a complex mathematical equation involving several joint probabilities which could include load, types of generation, generation operations, fuel supply, forced outages, environmental and transmission issues
  - Actually, having several smaller generators is more likely to produce a greater probability that demand will be satisfied than having one very large generator.



Utility Reserve Margin Planning

- On a stand-alone basis reserve margins have to be greater than if two or more utilities are acting in cooperation to provide reserves.
- Consider, for instance, a utility that is summer peaking merging with a utility that is winter peaking. Consider also, a utility with a very efficient nuclear unit and a very efficient coal-fired unit merging with a utility that has good gas peaking and cycling facilities but no baseload units. In the former case, load diversity improved the reliability of both. In the latter case, resource diversity improved the reliability of each of the merging entities.

Setting Planning Reserves is a matter Reserved to the States

- EPAct 05 makes it clear that states have the authority to set planning reserves.
- Due to the complexity of this task, many states have historically relied on NERC (now the North American Electric Reliability Corporation) and its regional reliability councils to set the reserve margins.
- As most state commissions have statutory authority to assure adequate reliability, state commissions' purview over reliability is comprehensive.

Electric Capacity Margins

North American Electric Reliability Corporation: Electric Capacity Margins Continue to Decline — Action Needed to Avoid Shortages

- **NERC Defines Bulk Power System Reliability in terms of two basic and functional aspects:**
- • **Resource Adequacy —** The ability of the bulk power system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.
- • **Operating Reliability —** The ability of the bulk power system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.
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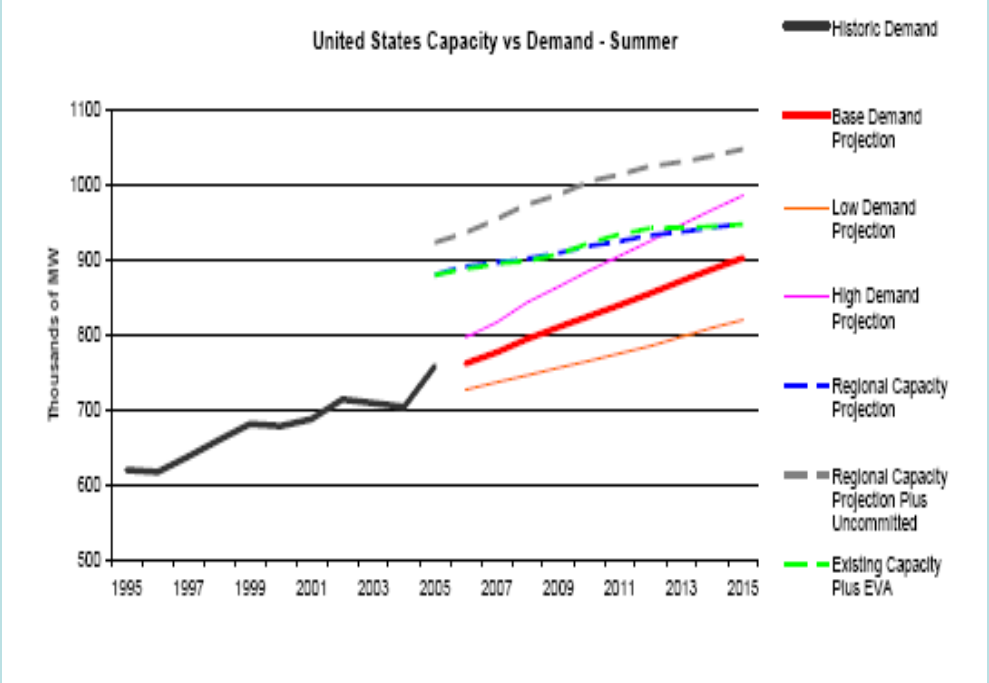
- **Need For Generating Capacity:** Resources are only expected to increase by 6 percent (57,000 MW) in the U.S...**IF** all resource additions that are in various stages of planning, licensing, or construction will come into service on schedule.



Electric Capacity Margins

North American Electric Reliability Corporation: Electric Capacity Margins Continue to Decline — Action Needed to Avoid Shortages

- **Transmission Capacity:** While the regions served by the Midwest ISO and PJM (Reliability First) have planned substantial transmission investment, in other regions, the lack of adequate transmission emergency transfer capability or transmission service agreements could limit the ability to deliver available resources from areas of surplus to areas of need. Despite the projected 19% increase in peak demand, total transmission miles are projected to increase by less than 7 percent in the U.S.

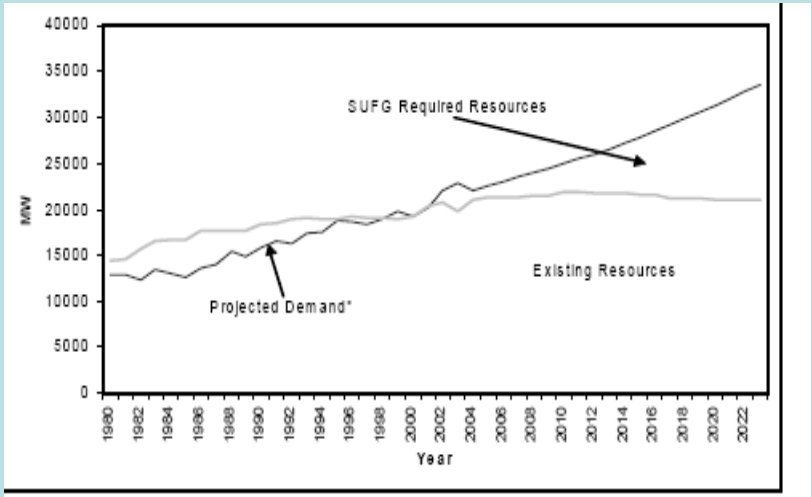
- **Demand Response**: Programs to reduce peak demand represent about 2.5 percent of summer peak demand (20,000 MW).

- **The Need for a Combination of Demand Reduction Programs, Generation, and Transmission:** Long-term electricity supply adequacy requires a broad and balanced portfolio of generation and fuel types, transmission, demand response, renewables, and distributed generation; all supply-side and demand-side options need to be available.

Electric Capacity Margins

The Need For New Resources in Indiana

- RTOs may provide an appropriate vehicle for states to work together with power suppliers to better coordinate construction of new cost-effective generation, transmission facilities, and demand response.
- Traditionally, utilities planned facilities as if they were islands with, often, little regard for their neighbors.
- In the 1970s and the 1980s, there was considerable "excess generating capacity" that were subject to prudence reviews that often resulted in substantial disallowances of costs. This, in turn, led to utility defaults and bankruptcies.
- The Commission's State Utility Forecasting Group (SUFG) at Purdue noted in their December 2005 Forecast that peak demand in Indiana is growing at a 2.24% annual rate
- This load growth translates into 500 MW of additional peak demand
- This forecast identifies a relatively balanced need for all three types of resources in the short term, with 860 MW of peaking, 1,170 MW of cycling, and 940 MW of baseload resources required by 2010
- For planning purposes, SUFG assumed a 15 percent reserve margin for the state. Due to diversity in demand among Indiana's utilities, a statewide 15 percent reserve margin occurs when individual utility reserve margins are roughly 11percent. Region-wide, it could be less



Capacity Margin Planning

- Utilities seem to go through “boom” and “bust” cycles (going from being capacity deficient to having surplus capacity) in building new generation
- Our State Utility Forecasting Group has estimated that Indiana utilities, by virtue of their involvement in the Midwest ISO and PJM, can reduce their traditional planning reserve margins of 15% to 11%.

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