Pacific Northwest Resource Adequacy Standard

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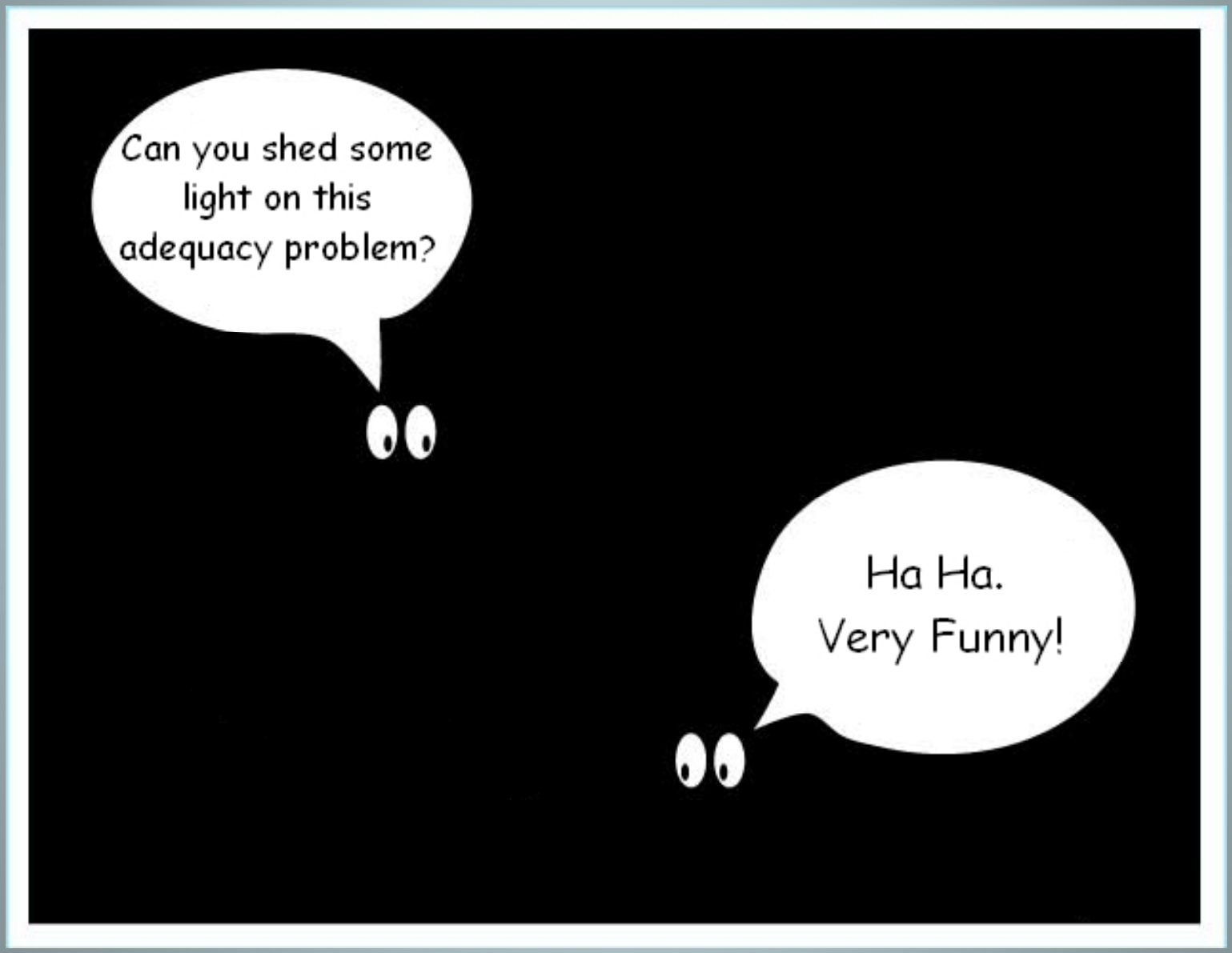
San Diego, California

July 27, 2012

Outline

- What is Resource Adequacy?
- The PNW Adequacy Standard
- State of the System Report
- Current Assessment for the PNW

What is Resource Adequacy?



Adequacy vs. Reliability

- The **North American Electric Reliability Corporation** defines power system reliability to be composed of two basic and functional aspects of the electric system:
- **Adequacy** - The ability of the electric 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.
- **Security** - The ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.
- **Thus, adequacy is a part of reliability**

What is an Adequacy Standard?

- **Adequacy** = having sufficient supply
- **Metric** = a quantitative measure (of adequacy)
- **Threshold** = a minimum level for an adequacy metric
- **Standard** = setting a threshold for an adequacy metric

Forum's Adequacy Metrics

Metric	Description
LOLP	Loss of load probability = number of games with a problem divided by the total number of games
Use of Standby	Number of games that dispatch standby resources at least once divided by total games
CVaR (energy)	Conditional value at risk = average annual curtailment for 5% worst games
CVaR (peak)	Conditional value at risk = average single-hour curtailment for worst 5% of games
EUE	Expected unserved energy = total curtailment divided by the total number of games
LOLH	Loss of load hours= total number of hours of curtailment divided by total number of games
LOLE	Loss of load expectation = total number of events divided by total number of games

Sample Adequacy Thresholds

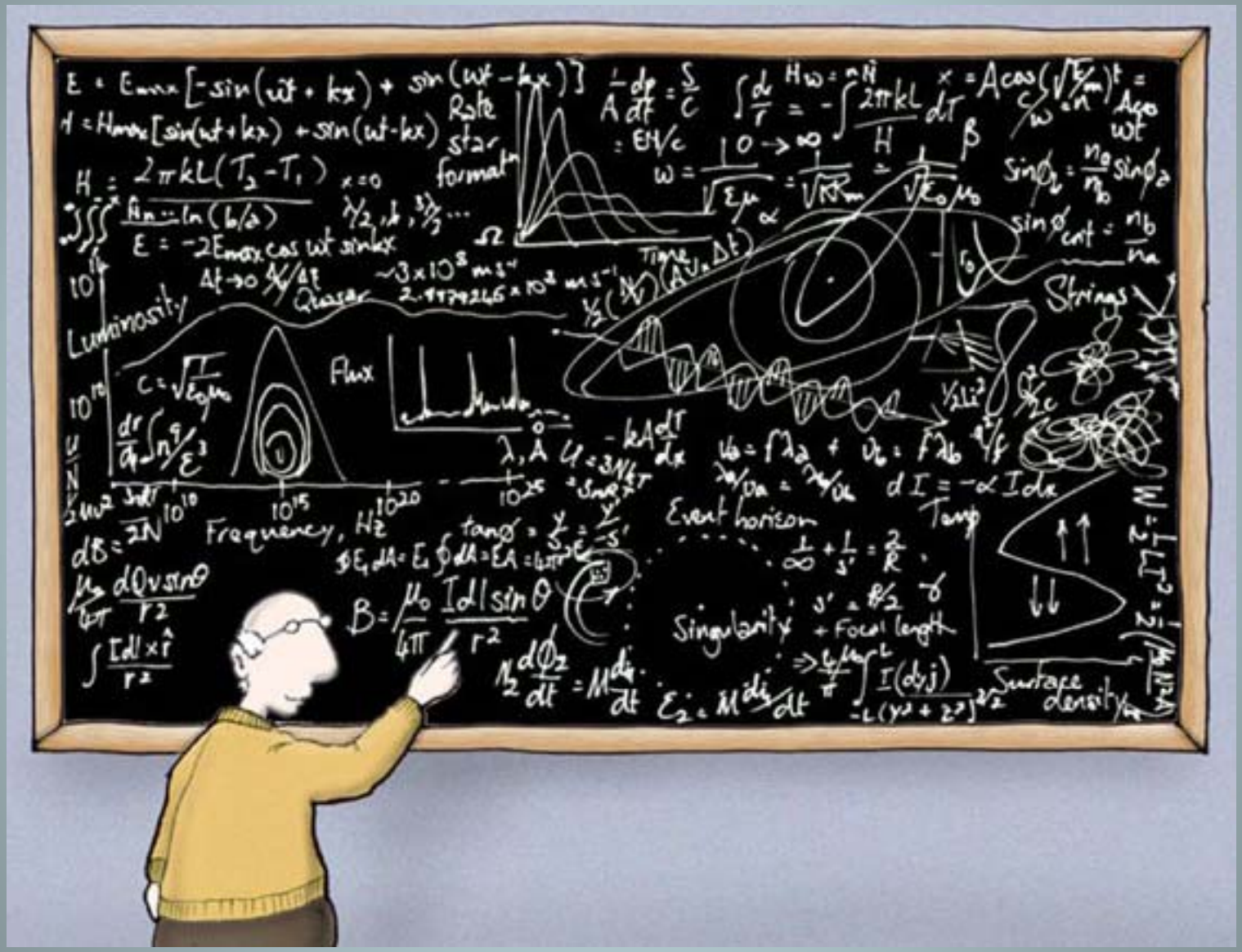
Metric	Threshold
LOLP	5 percent (used in the PNW)
Use of Standby	Not commonly used
CVaR (energy)	No common threshold
CVaR (peak)	No common threshold
EUE	No common threshold
LOLH	Ranges up to 2.4 hours/year
LOLE	1 event/10 years or 0.1 event/year

Physical vs. Economic Adequacy

- **Physical** = “keeping the lights on”
- **Economic** = “keeping rates low and minimizing annual price fluctuations”

- Economic adequacy is generally a higher standard (e.g. more controllable supply)
- Economic adequacy is usually targeted in integrated resource plans (IRP)
- Physical adequacy is an “early warning” when resource development falls short for unexpected reasons

The PNW Adequacy Standard



The Pacific NW Adequacy Standard

- Is a physical standard
- Assumes no transmission outages
- Uses the LOLP metric
- Sets a 5% threshold for the LOLP
- Assess adequacy 5 years out, assuming existing or expected resources (including conservation)

Interpretation of the Standard

- The likelihood of having at least one curtailment* five years into the future must be 5% or less for the power supply to be deemed adequate.

- Intended to be an early warning should resource development fall dangerously short
- Does not take economic factors into consideration
- Not intended to be a resource needs assessment but could be used to support one
- Used as a safeguard in the Council's resource strategy model

* This represents a simulated curtailment. In reality, it represents the likelihood of having to take extraordinary measures to continue to provide service.

Adequacy Standard Methodology (1)

- Use a chronological hourly Monte Carlo simulation computer model (GENESYS)
- Run many simulations (games) with different values for future unknown variables
- Future unknown variables include:
  - Water supply
  - Temperature (load) variation
  - Wind generation
  - Forced outages

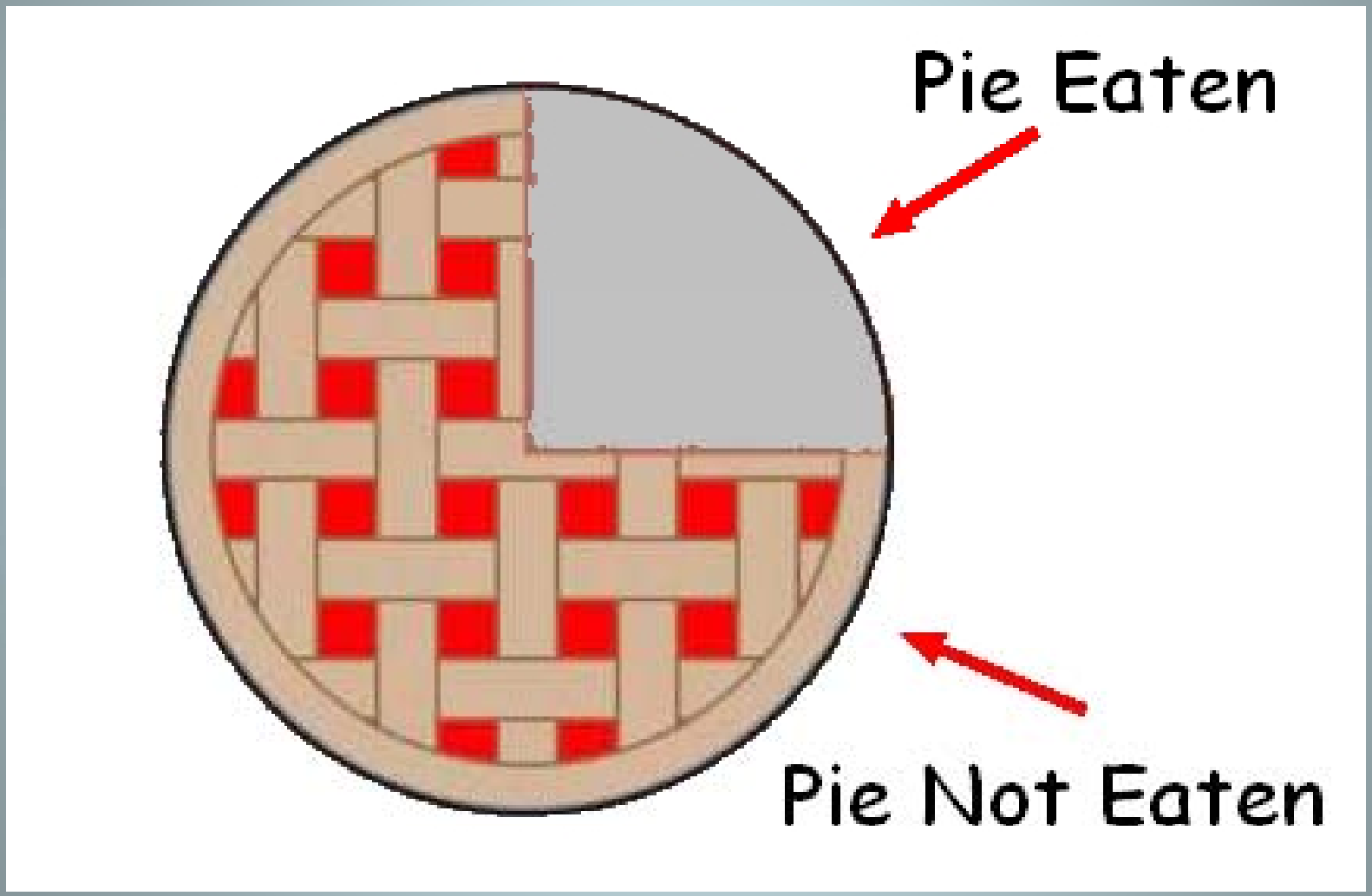
Adequacy Standard Methodology (2)

- Model the transmission capacities of:
  - East-west regional interties
  - NW to SW interties
  - NW to Canada interties
- Include an amount of market supply that we are reasonably sure will be available
- Simulate the operation over every hour of every month

Adequacy Standard Methodology (3)

- Any game in which at least one curtailment occurs is considered a “bad” game
- LOLP = number of bad games divided by the total number of games
- The number of curtailments per game and the magnitude of curtailments **do not** affect LOLP
- A ***State of the System*** report provides more detailed information about the power supply, which includes frequency and magnitude

The State of the System Report



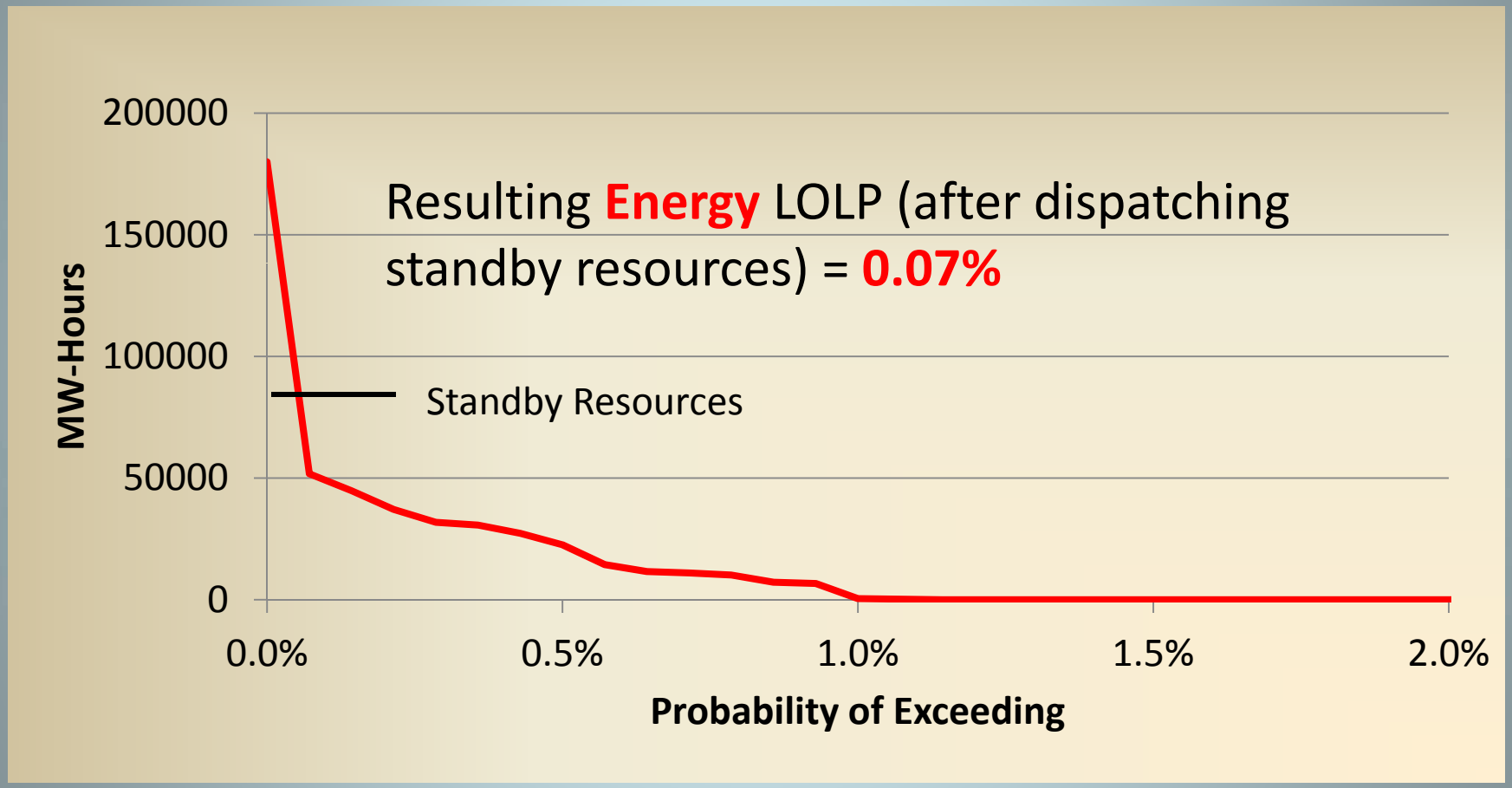
The State of the System Report

- LOLP value and adequacy status
- Values for additional adequacy metrics
- Monthly breakdown of LOLP
- Monthly and hourly use of resources and market supply
- Curtailment statistics

DRAFT Adequacy Assessment for 2015 (Not for Distribution)

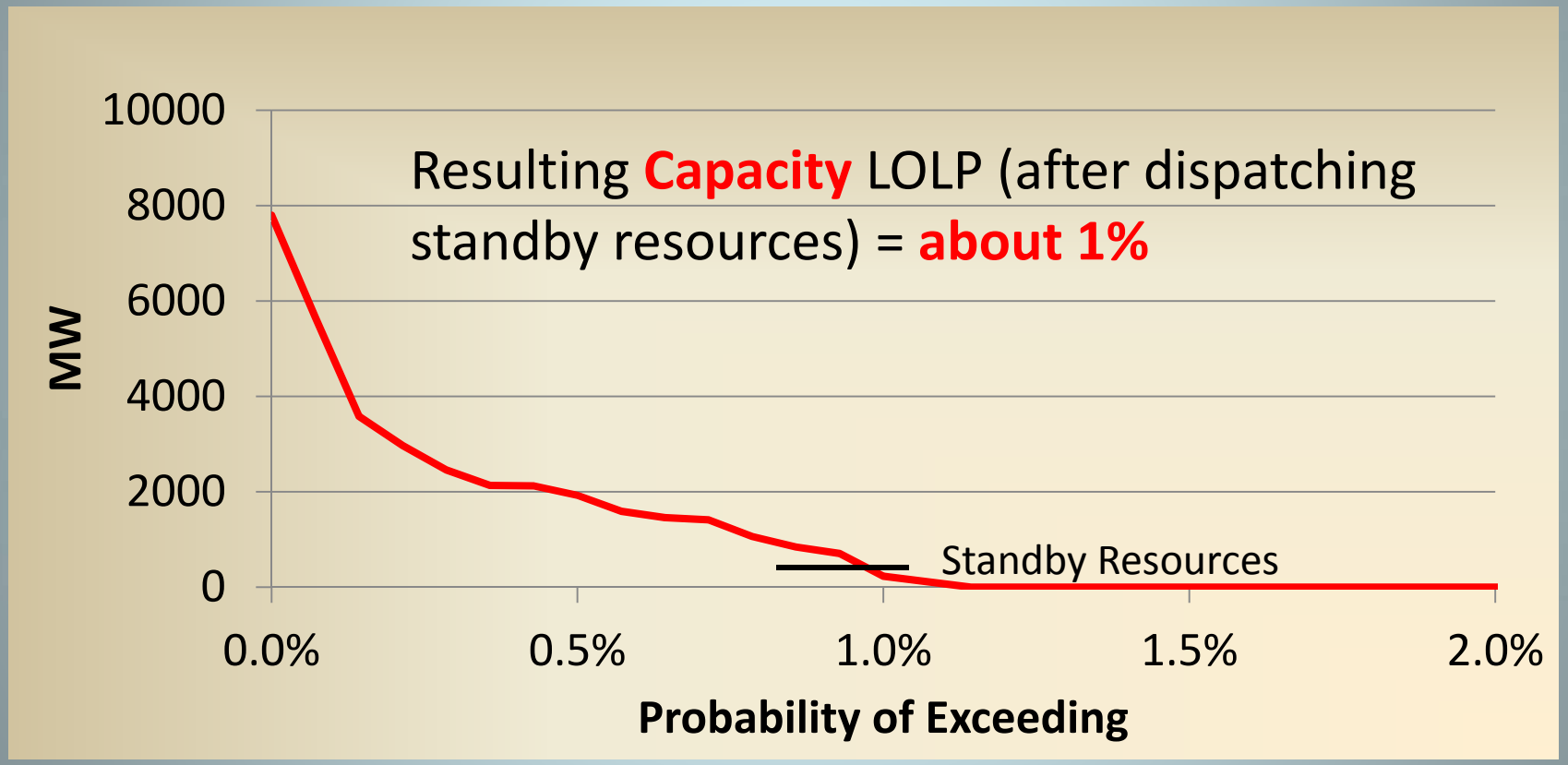
Metric	Value	Units	Threshold
LOLP	**0.93%**	**Percent**	**5%**
Use of Standby	**1.1%**	Percent	N/A
CVaR (energy)	**6,968**	MW-hours	N/A
CVaR (peak)	**516**	MW	N/A
EUE	**348**	MW-hours	N/A
LOLH	**0.3**	Hours/year	0.8 to 2.4
LOLE	**0.02**	Events/year	0.1

Total Annual Energy Curtailment Probability Curve*



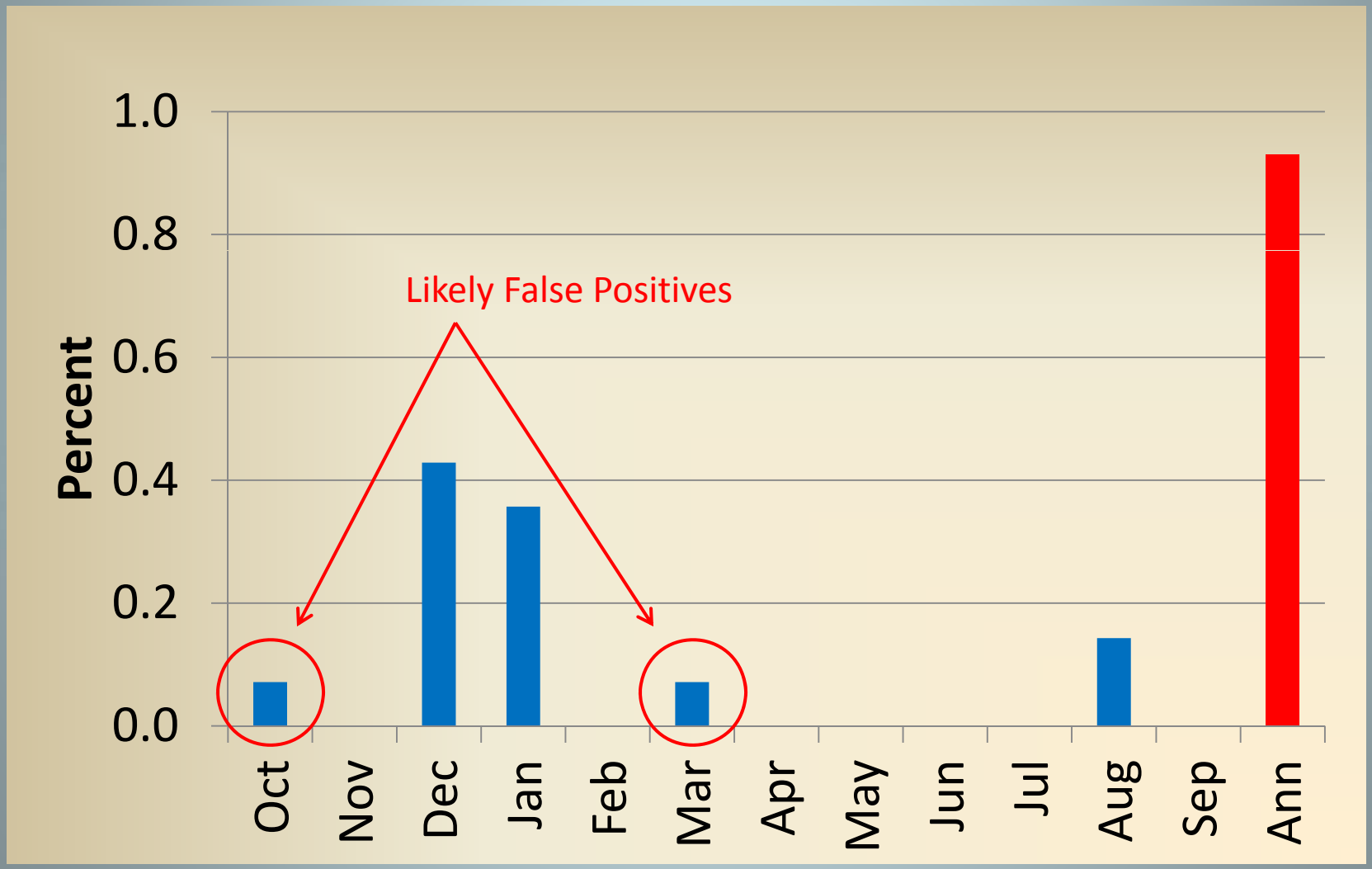
*Prior to dispatching standby resources
Standby resource energy = 83,000 MW-hours per year

Highest Single-Hour Curtailment Probability Curve*

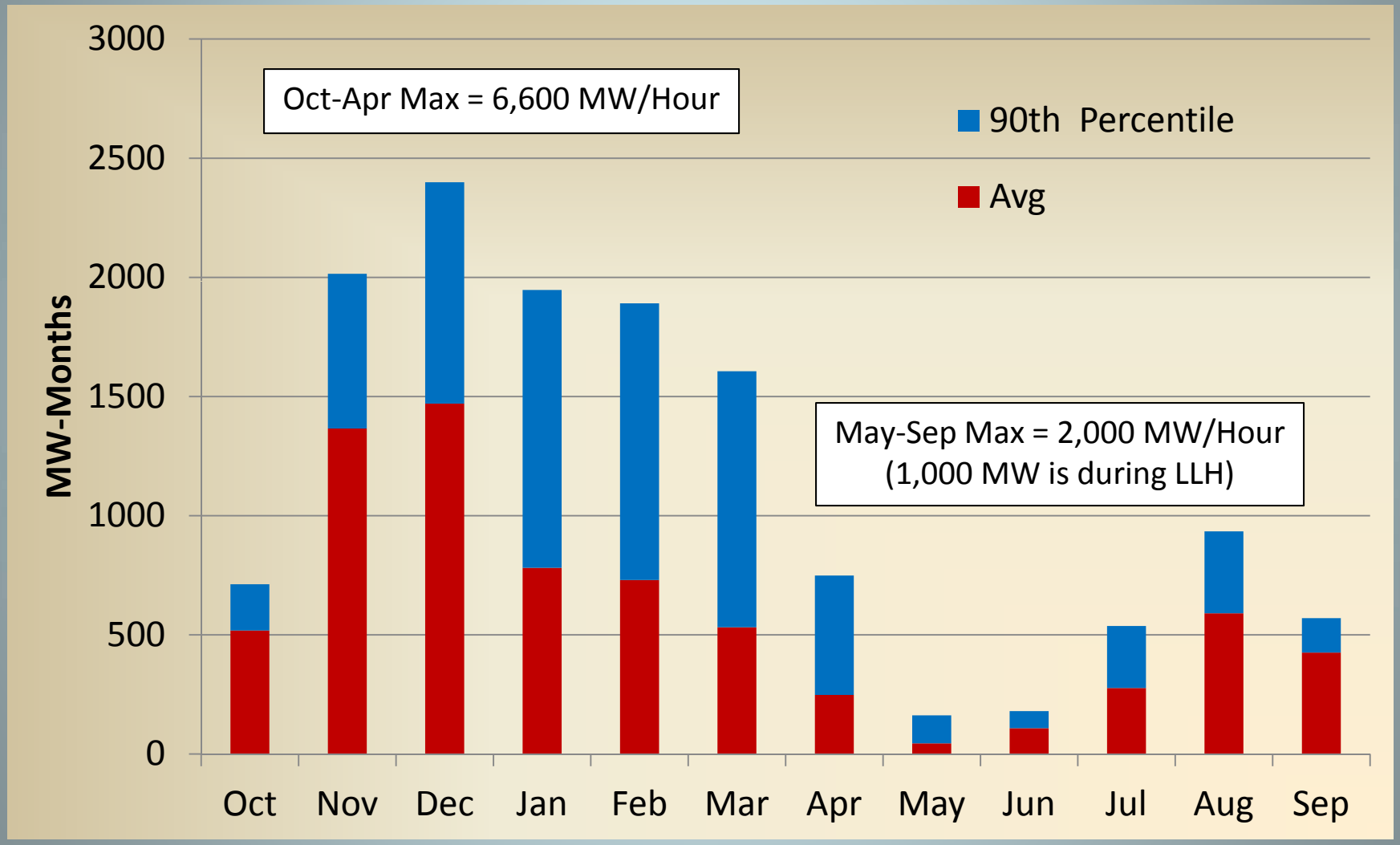


*Prior to dispatching standby resources
Standby resource capacity = 662 MW in winter and 722 MW in summer

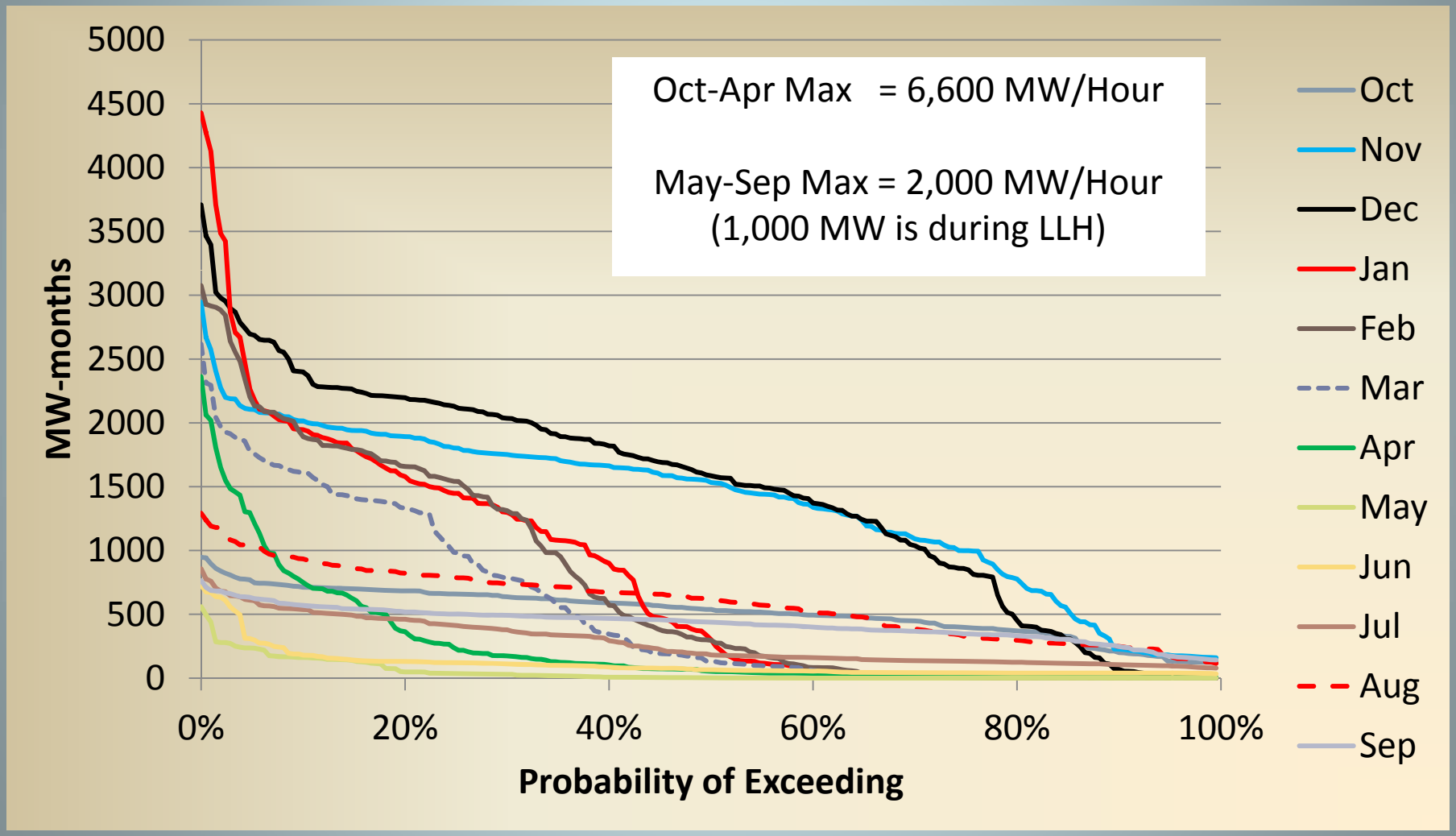
Monthly LOLP
(Months are treated independently)



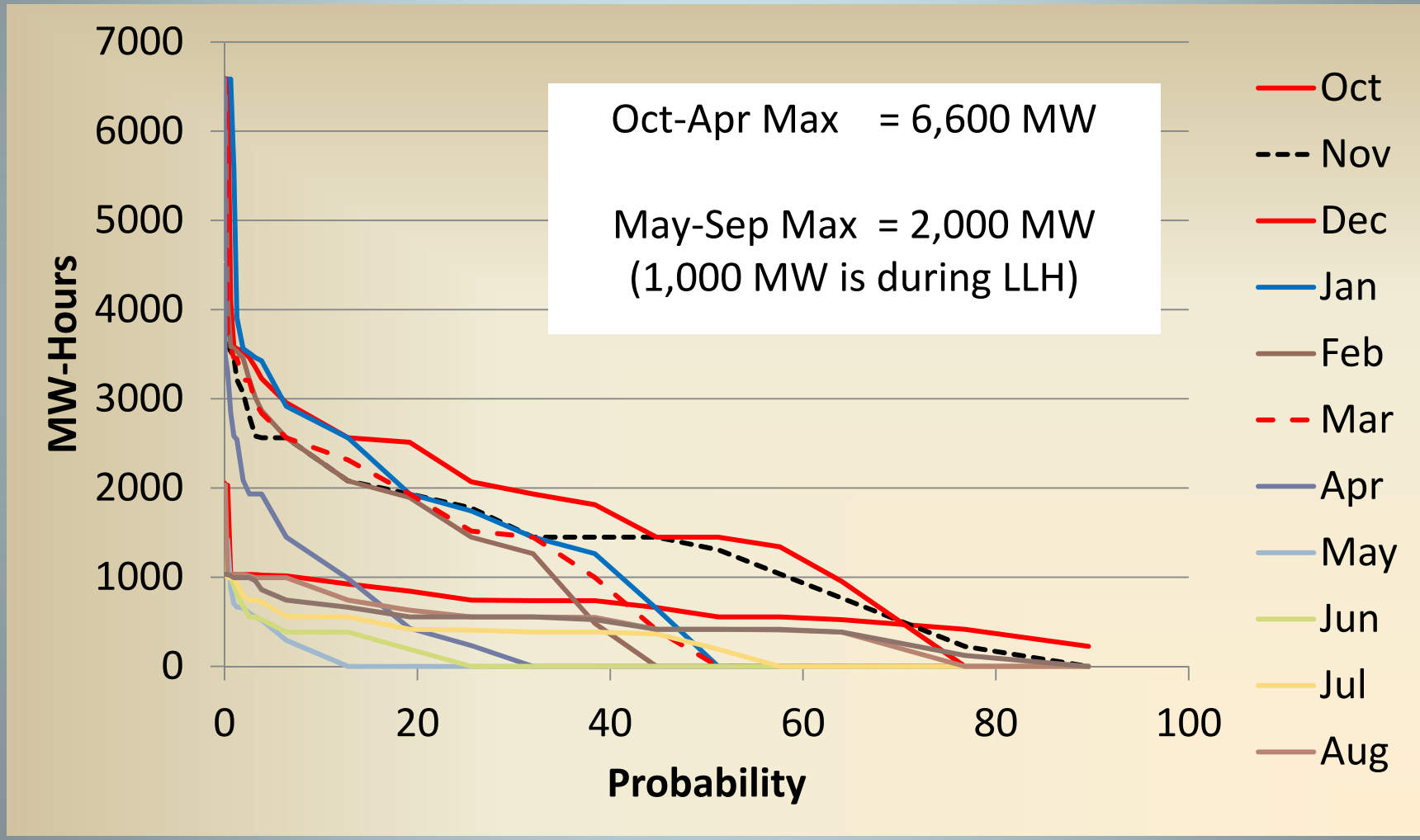
Market Purchases by Month



Average Monthly Market Purchase Probability



Market Purchases by Hour

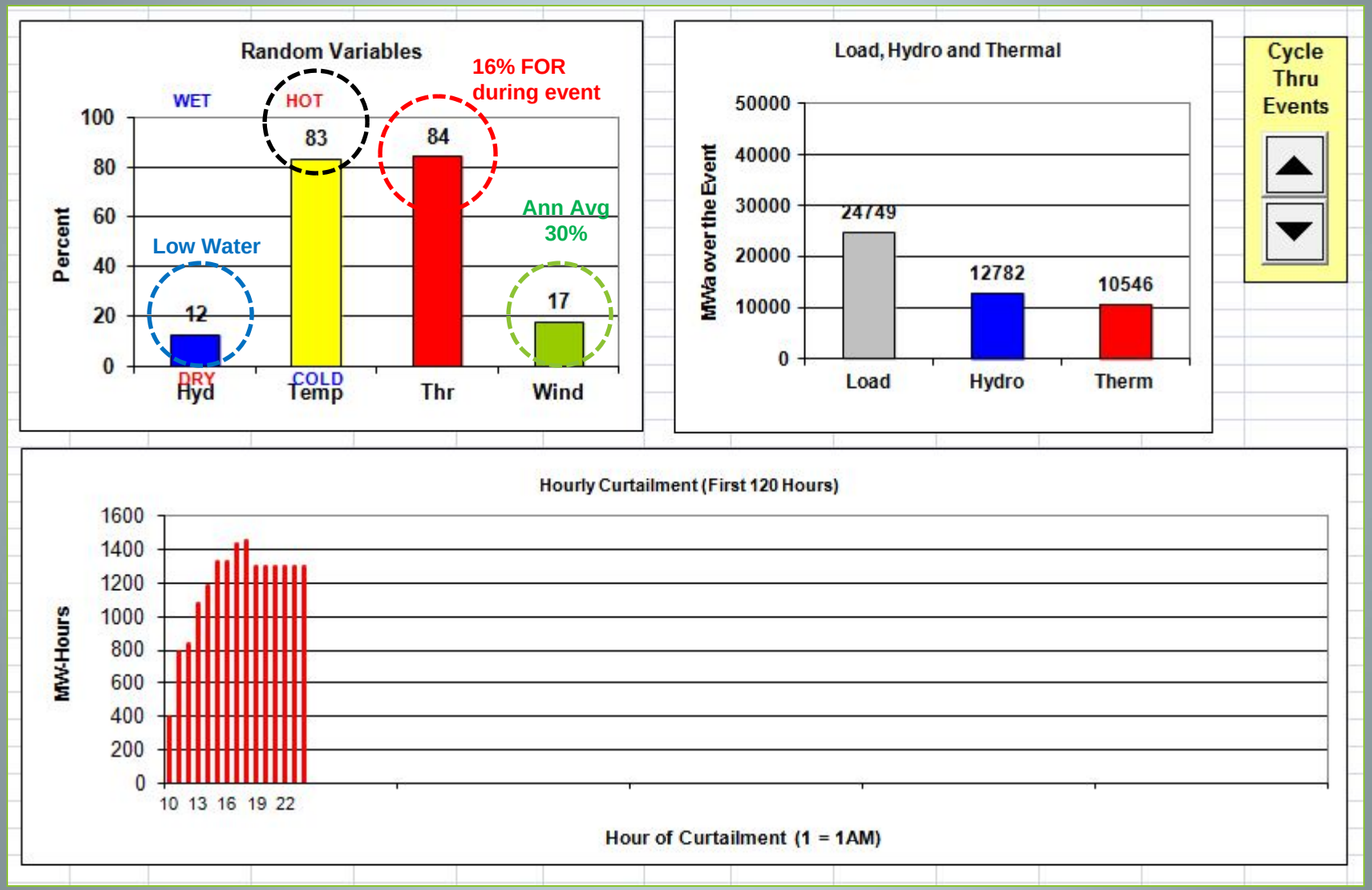


Curtailment Statistics

Statistic	Value	Unit
Expected Events/year	**0.02**	Events/year
Average Event Duration	**15**	Hours
Average Event Magnitude	**21,206**	MW-hours
Average Event Peak	**1,697**	MW
Expected Curt Hours/year	**0.3**	Hours/year
% of Games with Curtailment*	**1.1%**	%

*Prior to dispatch of standby resources

Conditions during an August Curtailment Event



Draft Adequacy Assessment for 2015 (Not for Distribution)

- **Supply is adequate** (LOLP < 5%)
- LOLP dominated by peak events (i.e. not energy)
- Most critical months are Dec, Jan and Aug
- Adequacy depends on fair amount of market purchases
  - December average = 23% of total market
  - August average = 30% of total market
- However, full amount of market purchases are made less than 1% of the time
- System becomes inadequate when the combined increase in peak load and decrease in efficiency is about 2,000 MW