Frequency Control
Research Needs

Howard F. Illian, President
Energy Mark, Inc.
March 9, 2010
Overview

- Energy Mark’s Template for Funding
- Examples of Current Needs
- Conclusions
Energy Mark’s Template

- Define the “Big Picture”
- State the “Underlying Assumptions”
- Forecast how the “Future Differs”
- Define “Nature of Acceptable Solutions”
- Results support “Substantive Decisions”
All interconnections follow the Law of Conservation of Energy.

Therefore, electric energy must be injected into an interconnection at the same instant that it is extracted by the customers.

Frequency Control addresses this requirement for the total electrical interconnection.
Operations must be planned and studied to insure reliability

Industry planning models address this problem over many time horizons

- Frequency Response Modeling
- Long-term & Mid-term Capacity
- Day and Hour-ahead Operations
- Hour-ahead & Short-term Operations
- External Reliability Limits Modeling
“Big Picture”
- Simulate frequency disturbances for about 10 to 15 seconds following a disturbance.

“Underlying Assumptions”
- The minimum frequency occurs within the first 10-15 seconds.

The “Future Differs”
- The Frequency Response Characteristic changes.
Actual & Natural Simulated

Actual and Natural Simulated Frequency Response
845 MW Disturbance

- Actual Frequency (Hz)
- Natural Simulated Frequency (Hz)
Frequency Response 1990’s

Frequency Response

1,200 MW
60.015 HZ - 59.985 HZ

4,000 MW
0.1 HZ

Eastern Interconnection
Frequency Response 2007

Eastern Interconnection

No “Point C” to “Point B” Recovery

Response “Withdrawal”
Frequency Response Models

➢ “Acceptable Solutions”
   ◆ Modify the models to extend the effective horizon to 30 seconds of more.
   ◆ Reverse the changes in system operations that have caused the change in the Frequency Response Characteristic.

➢ “Substantive Decisions”
   ◆ Demonstrate need to reverse the change.
   ◆ Demonstrate models that match the Frequency Response Characteristic.
External Reliability Models

“Big Picture”
- Most operations planning models are deterministic.
- Reliability requirements are estimated externally and implemented by setting model limits such as reserves.

“Underlying Assumptions”
- This method of estimating reliability limits externally provides appropriate reliability risk levels.
External Reliability Models

The “Future Differs”

- Current methods of setting external reliability limits are deterministic and unrelated to measurable levels of risk.
- They depend on the future being similar to the past.
- Numerous events and responses jointly contribute to frequency reliability risk.
- The future will include risk drivers that differ from any previously experienced.
ERCOT Wind Event

Wind Output and Frequency for 1/28/10

Sample Time

MW (Wind)

Hz (Freq)

9:00 10:00 11:00 12:00 13:00 14:00 15:00

Texas Interconnection
Contingency Reserve (RRS)

Wind Output, Regulation and RRS for 1/28/10

Sample Time
- Aggregated WGR Output
- Total Reg. Deployed
- Total RRS Deployed

Texas Interconnection
External Reliability Models

“Acceptable Solutions”
- Replace the deterministic models and reserve rules with probabilistic models that estimate the joint risks.
- Modify these models as system conditions change.

“Substantive Decisions”
- Use the external reliability models to provide risk parameters to the current planning models.
Conclusions

- Energy Mark recommends five steps
  - Define the “Big Picture”
  - State the “Underlying Assumptions”
  - Forecast how the “Future Differs”
  - Define “Nature of Acceptable Solutions”
  - Results support “Substantive Decisions”

- Energy Mark’s experience indicates that good definitions and planning of research leads to successful results and ongoing funding.
Questions