Northwest Power and Conservation Council

April 30, 2013

MEMORANDUM

TO: Power Committee

FROM: Michael Schilmoeller, Senior Power Systems Analyst

SUBJECT: A Proposed Metric to Assess Power System Flexibility

The Action Plans of the Council's Fifth and Sixth Northwest Power Plans called for the Council to develop improved methods to measure the need for, and sources of, power system flexibility. In recent years large amounts of wind power have been developed in the region, further underscoring the importance of addressing this topic.

At the Power Committee meeting on May 7th, I will introduce a proposed new approach to quantify requirements for power system flexibility at the sub-hourly level. The technique can also be used to determine whether a given portfolio of resources is sufficient to provide the needed flexibility. The presentation is for background purposes and no decision by the Power Committee is necessary.

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A New Approach and Metric for Assessing Power System Flexibility

Michael Schilmoeller
Power Committee Meeting
May 7, 2013
Boardman, Oregon

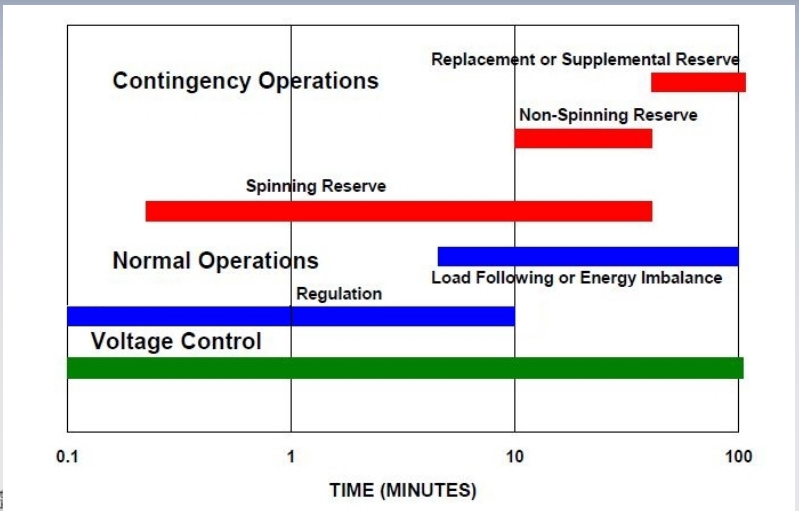
Overview

- What problem are we trying to solve?
- Why does it matter?
- What does the proposed metric look like?

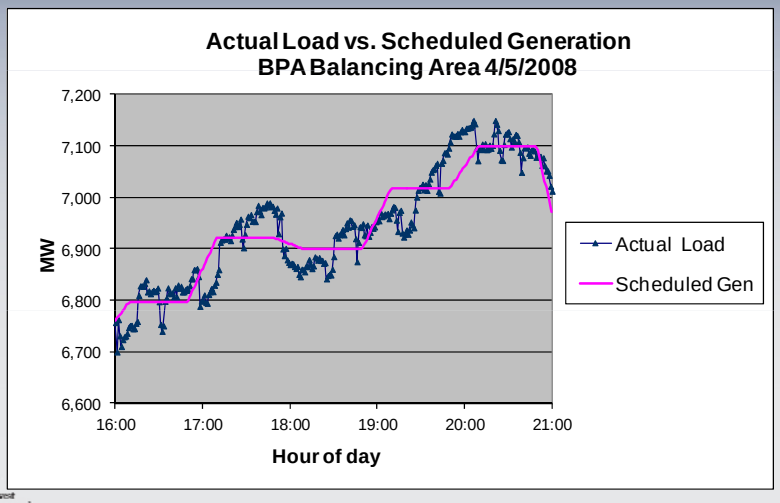
Power Scheduling and Balancing

- Power is scheduled week ahead, day ahead, and hour ahead to balance the system
  - This is part of a continuous process
- Balancing depends on forecasts of need
- Addition of variable energy resources (VERs) has increased the challenge of balancing within the hour

Ancillary Services, Continued



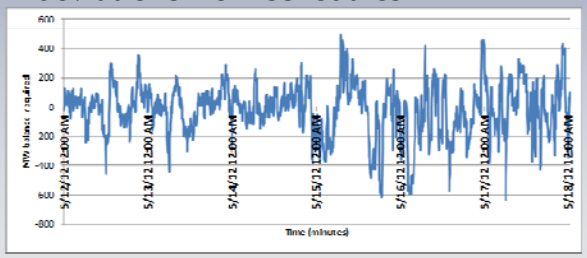
Deviations from Schedule



The Problem: Sub-Hourly Deviations

- We want to *characterize* this requirement for resources to meet short-term deviations from schedules

This is a sub-hourly issue – these observations are 5-minute deviations



- We would like to know what kinds of resources are needed to balance the power system (or whether a given resource ensemble suffices)
- This is nothing new – power systems have always had this behavior and we have always had to plan for it

Why is a New Approach Needed?

- Other approaches treat this pattern like a noise signal
  - They *only* tell us the ***maximum*** capacity and ramp rate requirements over periods
  - Therefore, they *do not* provide insight into how resources with ***lower*** ramp rates can participate
- Consequently, they provide *little* information that would help us find ***least-cost solutions***

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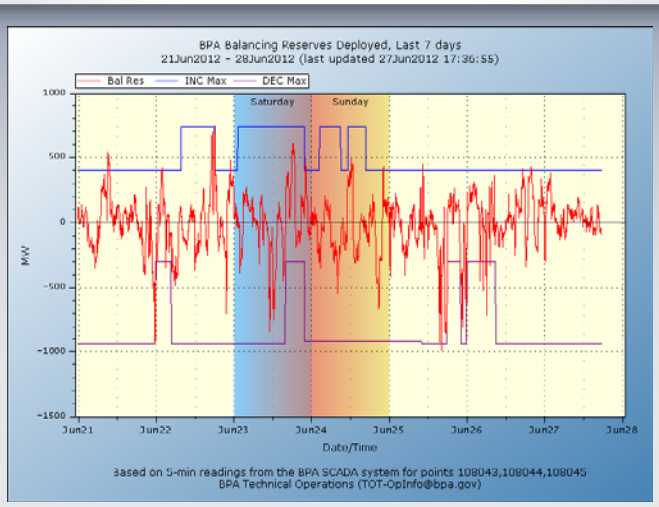
Current Approach



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Analogy

- Existing metrics tell us how many Formula-1 race cars the ACME delivery company should have in its fleet
- ... but Formula-1 race cars are expensive, and some needs can be met with other, less costly vehicles
- We need a metric that tells us how many vans, sedans, bicycles, Segways, and ... yes ... race cars would also meet the ACME delivery company's requirement
- A diversified fleet of vehicles can save ACME a lot of money

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Why Does it Matter?

- Higher penetration of variable generation resources (wind and solar)
- Growing constraints on the hydrogeneration system
- Because the region asked for it and the Council promised to do it
  - Action Gen-8 of the 5th Power Plan
  - Action Gen-5 of the 6th Power Plan
- Because we need to evaluate a growing list of proposed solutions, which can be used *in combination* to meet system balancing needs

Other Potential Solutions

- Energy Imbalance Markets (EIM) and 5-minute schedules
- ACE diversity interchange (ADI)
- Reserve sharing
- Resources displaced by energy efficiency and any dispatchable forms of renewables
- Reliability-Based Control (RBC)
- Demand Response and Smart Grid
- Batteries and storage
- Additional supervisory control system (SCADA) and automatic generation control (AGC)
- Dynamic scheduling services and Interaction Acceleration Platforms (IAP)
- Better monitoring of the state of the system

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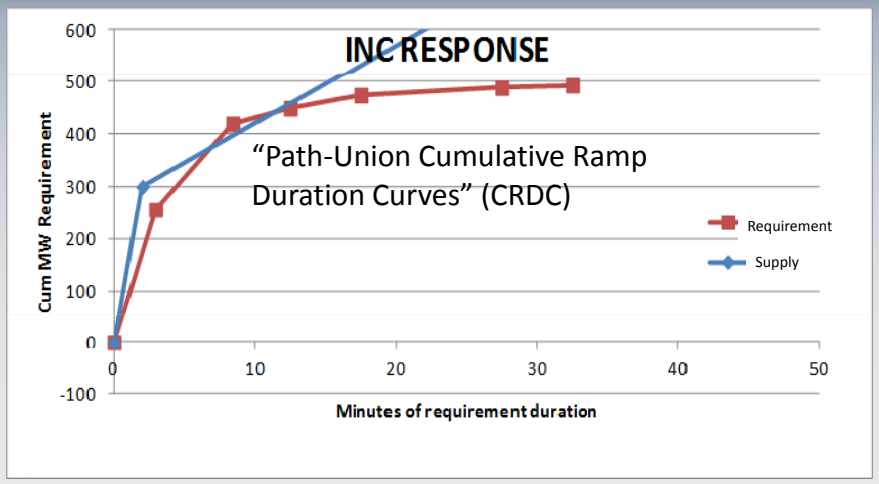
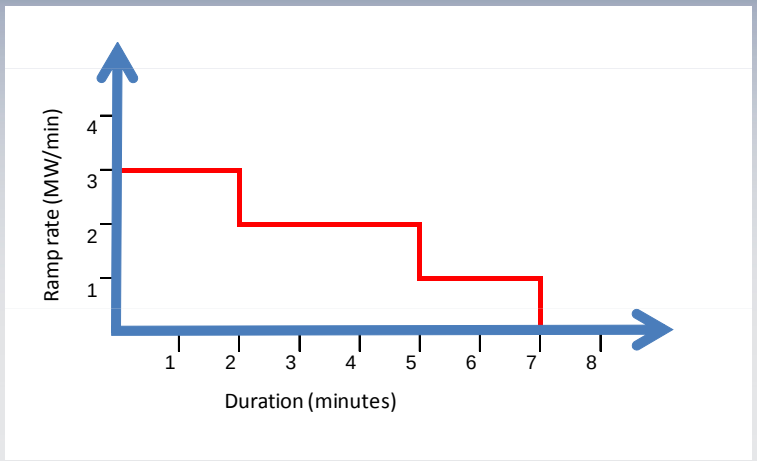
A New Approach



Power System Ramping Need



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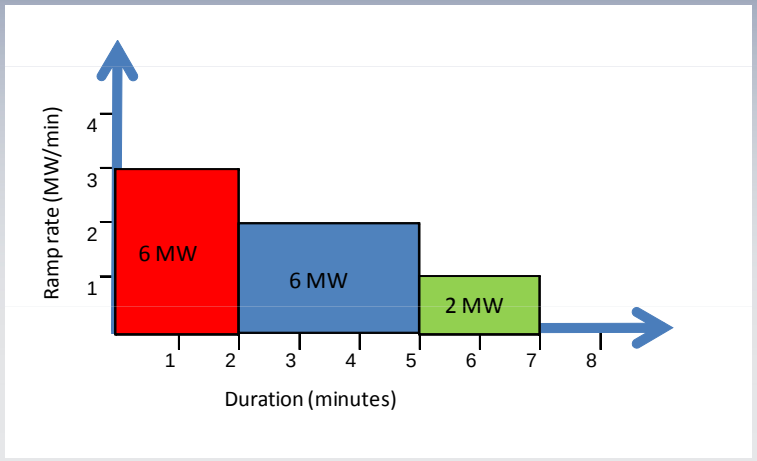
System Resource Candidates



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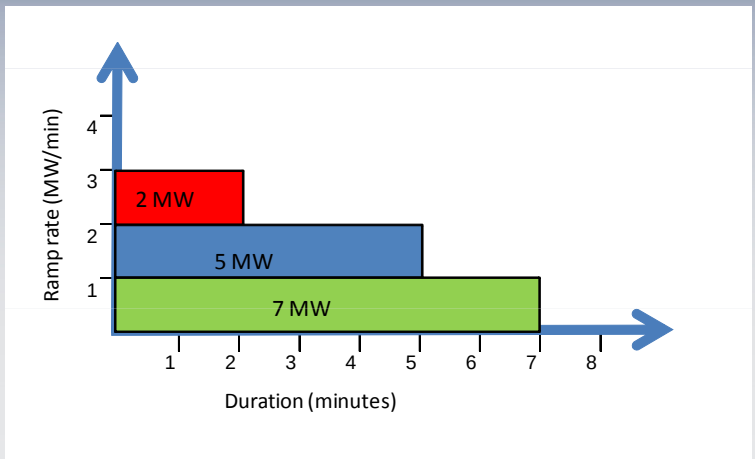
System Resource Candidates



Summary

- The *Cumulative Ramp Duration Curve* tells us how resources and measures can be combined to meet power system balancing needs
- This approach is an improvement
  - Tracks *ramp rates* as well as the magnitude of the excursions
  - Tracks *the order* of requirements, reflecting the loading and substitution of machines to provide imbalance services
  - Helps identify cost-effective solutions

Summary

- Allows any portfolio of resources to be tested to see if it meets intra-hour power system flexibility needs
  - reveals sufficiency or insufficiency
- The new metric is fast to compute
  - can be used to address power system flexibility needs in multi-year studies and utility Integrated Resource Plans (IRPs)