Northwest **Power** and **Conservation** Council

December 2, 2014

MEMORANDUM

TO: **Power Committee Members**

FROM: **Ben Kujala, Systems Analysis Manager**
John Fazio, Senior Systems Analyst
John Ollis, Power System Analyst

SUBJECT: **Approach to Assessing Capacity, Balancing and Flexibility Needs**

BACKGROUND:

Presenter: Ben Kujala, NWPCC (bkujala@nwcouncil.org, 503-222-5161)

Summary: The issue of energy/capacity/flexibility can be broken down into two parts; 1) demand or how much of each does the region need, and 2) supply or what is the best way to provide for those needs? In reliable power systems, electricity generation must always match load within a small margin of error. A power system is adequate when this balance can be maintained without taking emergency actions such as curtailing load. If you add up all the electricity that can be imported or produced by regional generators and it at least meets the average regional load, then the system has adequate *energy*. If the power system can meet the highest loads (peak loads) and match generation to loads in all hours without falling outside the small margin of error then the system has adequate *capacity* and *flexibility*.

To assess energy and capacity needs, the staff proposes to use the Council's GENESYS model. In 2010, the Council adopted a regional adequacy standard that limits the loss of load probability (LOLP) to a maximum of 5 percent over the course of a year. The GENESYS model can determine the amount of energy and capacity that is needed to keep the LOLP at or below the 5 percent standard. For example, the

assessment for 2019 resulted in an LOLP of 6 percent. To bring that value into compliance with the Council's standard, 400 megawatts of dispatchable capacity or 280 average megawatts of annual energy (shaped to load) is needed.

To assess flexibility needs, the staff is proposing is to analyze both operating reserves and the ramping capability of the system. To assess the need for operating reserves, staff plans to develop granular data sets for load and non-dispatchable generation and use these data, along with reliability requirements for system operators, to estimate the regional need. To assess the ramping capability of the system (outside the operating reserve time-frame) staff is considering the use of the AURORAxmp model, with 80 hydroelectric generation shapes (based on the historical water record) years and 80 load shapes (based on historic regional temperatures). Work on this is ongoing and is being carried out with the assistance of the Council's System Analysis Advisory Committee. Staff has prepared a proposed memo that will solicit feedback from the Council's advisory committees on the approach the Council should take in assessing the operating reserves for the region. The draft memo is attached.

To address economics of minimizing the cost of satisfying energy and capacity needs, the staff proposes that the Council rely on its Regional Portfolio Model (RPM). This requires that the five percent LOLP adequacy standard first be translated into simpler deterministic metrics. For example, the energy metric might be a specified amount of minimum annual energy surplus and the capacity metric might be a specified amount of minimum peak-period surplus capacity. Once these metrics have been determined they can then be incorporated in the RPM as minimum resource acquisition levels.

To optimally satisfy flexibility needs, however, a more complex analysis is required. Council staff is working with others to develop an appropriate methodology. Part of that methodology will be integrating more comprehensive operating reserve logic into the Council's TRAP hourly hydroelectric model and its GENESYS model. Typically, the hydroelectric system has been used to carry these reserves, but concern has arisen that it may no longer be able to carry all required operating reserves. Council staff will examine ways to use non-hydro resources (perhaps including demand response) to carry some of these reserves. Concurrently, the region is investigating the creation of an Energy Imbalance Market, which may change the supply of and demand for flexible resources in the region.

Relevance: The Council's resource strategy is a blueprint for regional generating resource and energy efficiency resource acquisitions. This resource strategy must now include provisions to meet the region's energy needs as well as its capacity and flexibility needs. Potential new generating resources and energy efficiency resource acquisitions and demand response options must be evaluated by their impacts on the system requirements for energy, capacity and flexibility.

Work Plan: 1.D (5) Develop flexibility analysis method

Background: The region's power supply has become more complex over the past several decades. Planners from 30 or 40 years ago could simply design resource strategies to meet the energy needs of the region. The vast capability of the hydroelectric system was generally sufficient to provide for capacity and flexibility needs. However, with the addition of over 8,000 megawatts of variable generation resources (wind) and with increasing constraints being placed on the operation of the hydroelectric system, the region can no longer assume that capacity and flexibility needs will be satisfied by simply planning to meet energy needs.

More Info: Staff intends to actively solicit stakeholder input on its proposed approach for incorporating capacity requirements into the RPM for the development of the Seventh Plan. This will include discussions with the Council's System Analysis Advisory Committee and PNUCC's System Planning Committee. Staff will also engage these same groups on its proposed framework and analytical approach to addressing system operating reserves and flexibility. A draft memo that is intended to solicit feedback from the Council's advisory committees on a proposed technical analysis approach to determining system operating reserves and flexibility is attached.

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MEMORANDUM

TO: Advisory Committee Members and Interested Parties

FROM: Council Staff

SUBJECT: Potential 7th Power Plan Operating Reserves Study

I. What Are Reserves?

The Power Act states *"Reserves" means the electric power needed to avert particular **planning or operating shortages** for the benefit of firm power customers of the Administrator*. In the Northwest region, every Balancing Authority (BA) has varying resources and operating practices, which can make the definition of reserves a bit ambiguous. Generally, reserves are broken into planning reserves, operating reserves and contingency reserves. The Council currently uses the GENESYS model to estimate planning and contingency reserves. Many BAs further categorize operating reserves into frequency controls, regulation reserves, and load following reserves. Frequency controls are automated responses required of large generators to maintain the 60 hertz system operating cycle, regulation reserves are usually dispatched based on the ACE (Area Control Error) and load following reserves are usually dispatched to balance changes in load or non-dispatchable generation that deviate from the BAs scheduled interchange, that is, scheduled imports and exports of power.

II. Why Study Operating Reserves?

The act indicates that the Power Plan *should include a forecast of power resources estimated by the Council to be required to meet the Administrator's obligations … which forecast (i) shall include regional reliability and reserve requirements.* The act goes on to emphasize that the Power Plan should include *an analysis of reserve and reliability*

requirements and cost-effective methods of providing reserves designed to insure adequate electric power at the lowest probable cost.

The definition of reserves in the Act covers both planning and operating shortages. An operating shortage could occur from inadequate contingency or operating reserves. The Council already assesses the need for contingency reserves in its regional adequacy analysis using its GENESYS model. Therefore, it seems appropriate to add an analysis of the operating reserve requirements for the region to the power plan. Further the power plan should look at cost-effective methods for supplying all reserves, planning, contingency and operating.

III. What Would an Operating Reserve Study Entail?

An operating reserve study would need to forecast the requirement for reserves over the planning horizon and asses the ability of the existing power system to supply those reserves. If the reserves provided by the current power system are insufficient then the study would need to provide options for increasing the capacity of the power system to supply both planning and operating reserves. Further, to answer whether the reserves are adequate and being met at the lowest probable system cost, the study would need to examine the current and future cost of operating reserves and assess if alternative sources of reserves could be provided at a lower cost.

IV. Barriers to Completing an Operating Reserve Study

Conducting an analysis of operating reserves presents several significant challenges to the Council. First, available data relating to the operation of the power system, especially within an hour, are both limited and scattered. The historic hourly load data that the Council uses to produce its load forecast are reported to Federal Energy Regulatory Commission (FERC) on form 714 and are publicly available. However, in order to analyze the adequacy of operating reserves, much more granular data (i.e., sub-hourly) are likely needed or a method to capture the statistical distribution of load within the hour must be developed. For example, in order to forecast regulation reserve requirements, data or a representation of loads and non-dispatchable generation in a one-minute or less time-frame is needed. Similarly, forecasting load following reserves requires data or a representation of loads and non-dispatchable generation in the 5 to 10-minute time-frame.

Finally, the national standards for operating reserves, set by North American Electric Reliability Corporation (NERC), include both deviation of the scheduled interchange of power between a balancing authority and the rest of the interconnection as well as the deviation of the frequency of the interconnection. That is, each BA is judged on how well they balance their imports and exports of power as well as how close the Western Interconnection frequency is to 60 Hz. Analysis of whether operating reserves are sufficient to maintain the 60 Hz frequency of the interconnection in a planning context would be difficult at best.

V. Potential Data Sources for an Operating Reserve Study

There are several possible sources of data for analysis.

- FERC through order 784 has required jurisdictional transmission providers to post Area Control Error (ACE) on their Open Access Same-time Information System (OASIS) sites. These data do not differentiate between frequency deviation and schedule deviation.
- The Northwest Power Pool (NWPP) sponsored research by Pacific Northwest Nation Labs (PNNL) (into an Energy Imbalance Market (EIM). Quantifying the benefits of an EIM required collecting and analyzing data about operating reserve requirements. This report lacks sufficient detail to wholly inform an analysis for the Council's plan and the data supporting this report are not publicly available.
- The Western Electricity Coordinating Council (WECC) has completed several studies through their Variable Generation Subcommittee working with Environmental Economics (E3) and the Plexos software from EnergyExemplar.
- The National Renewable Energy Laboratory (NREL) synthesized sub-hourly data for an EIM study (*Operating Reserve Reductions From a Proposed Energy Imbalance Market with Wind and Solar Generation in the Western Interconnection*).

VI. Process for Studying Operating Reserves

Staff anticipates that the following would be required to complete a study of operating reserves.

1. A forecast of the distribution of frequency deviation of the Western Interconnection for the planning horizon to determine if it is expected to change, which would impact ACE
2. A simulation or forecast of the deviations from scheduled imports and exports of power for each BA for the planning horizon
3. A forecast of impacts from changes in scheduling practices for the planning horizon
4. Use these simulations and/or forecasts and the NERC standards to estimate the operating reserves requirements for the regional balancing authorities
5. Estimate the capability of the existing power system to supply operating reserves
6. Forecast the incremental resource need, if any, for operating reserves