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

August 4, 2015

MEMORANDUM

TO: **Council Members**

FROM: **Ben Kujala and John Ollis**

SUBJECT: **Proposed Approach to Balancing and Flexibility for Draft Plan**

BACKGROUND:

Presenter: Ben Kujala

Summary: Staff proposes to employ multiple models to test flexibility of the existing regional power system. If this approach proves workable it will be then be used to test potential changes to the existing regional power system resource mix based on the resource acquisitions and/or retirements that might occur under resource strategies drawn from the Regional Portfolio Model (RPM). In general, this modeling approach will test a resource portfolio's capability to simultaneously provide both intra-hour and inter-hour flexibility needs, while still meeting the regional resource adequacy standard.

The proposed first modeling step is to determine what reasonable intra-hour flexibility requirements are for the region. The intra-hour flexibility reserve requirements considered will be load following, regulation, spinning and non-spinning reserves. The load following and regulation reserves will be estimated by using stakeholder input to help guide the creation of a reasonable regional dataset. In accordance with the WECC balancing standard (BAL-002) spinning and non-spinning contingency reserves are currently estimated to cover three percent of load and three percent of generation resources or the largest, single contingency.

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Steve Crow
Executive Director

503-222-5161
800-452-5161
Fax: 503-820-2370

Once the amount of regional resources with sufficient capability to meet regional system intra-hour flexibility needs has been established, inter-hour ramping capability can be analyzed. This will be estimated by determining whether the remaining capabilities of regional resources are able to satisfy the inter-hour ramping requirements. If the resource portfolio being tested does not result in insufficient remaining ramping capability, then the regional portfolio being tested would be judged as adequate for flexibility purposes.

This approach will be applied to resource portfolios which have resource strategies that would likely increase regional flexibility requirements through the addition of variable generation resources.

Staff is presenting an initial proposal to the SAAC on August 4, 2015, on how to assign hydro and non-hydro resources within the existing regional portfolio to satisfy reserve requirements for each Balancing Authority. Feedback from the SAAC will be incorporated into the current methodology; Staff will continue its analysis and further progress will be reported at the August Council meeting.

Relevance: Since the RPM and GENESYS do not consider balancing and flexibility needs of the system, a methodology is needed to evaluate whether the region will need to consider modifying proposed resource strategies to ensure that system ramping and reserve needs can be met on a intra and inter-hour basis. The proposed approach seeks to address this problem.

Workplan: 1. B. Develop Seventh Power Plan and maintain analytical capability

- Define resource portfolio

Background: The RPM is used to examine the cost and risk of regional resource strategies at a quarterly time granularity. The GENESYS model was developed by the Council and over time has been modified with the advice of the Resource Adequacy Advisory Committee. The GENESYS model is used to assess regional power supply adequacy at an hourly granularity. The Council does not currently have a model that explicitly models intra-hour operations.

Intra-hour information can be used to inform hourly models by limiting the capability or range of a dispatch of plants by assigning reserve requirements to a particular plant or set of plants. Once this reserve requirement has been accounted for the remaining capability on those plants can then be assumed to be available for inter-hour ramping or economic dispatch. Hourly models like Aurora and/or GENESYS can be used to analyze inter-hour resource portfolio ramping capability under particular intra-hour reserve assumptions because the intra-hourly information has been accounted for by the assignment of intra-hour reserve requirements.

Proposed Approach for Assessing Balancing and Flexibility Reserves in the Region

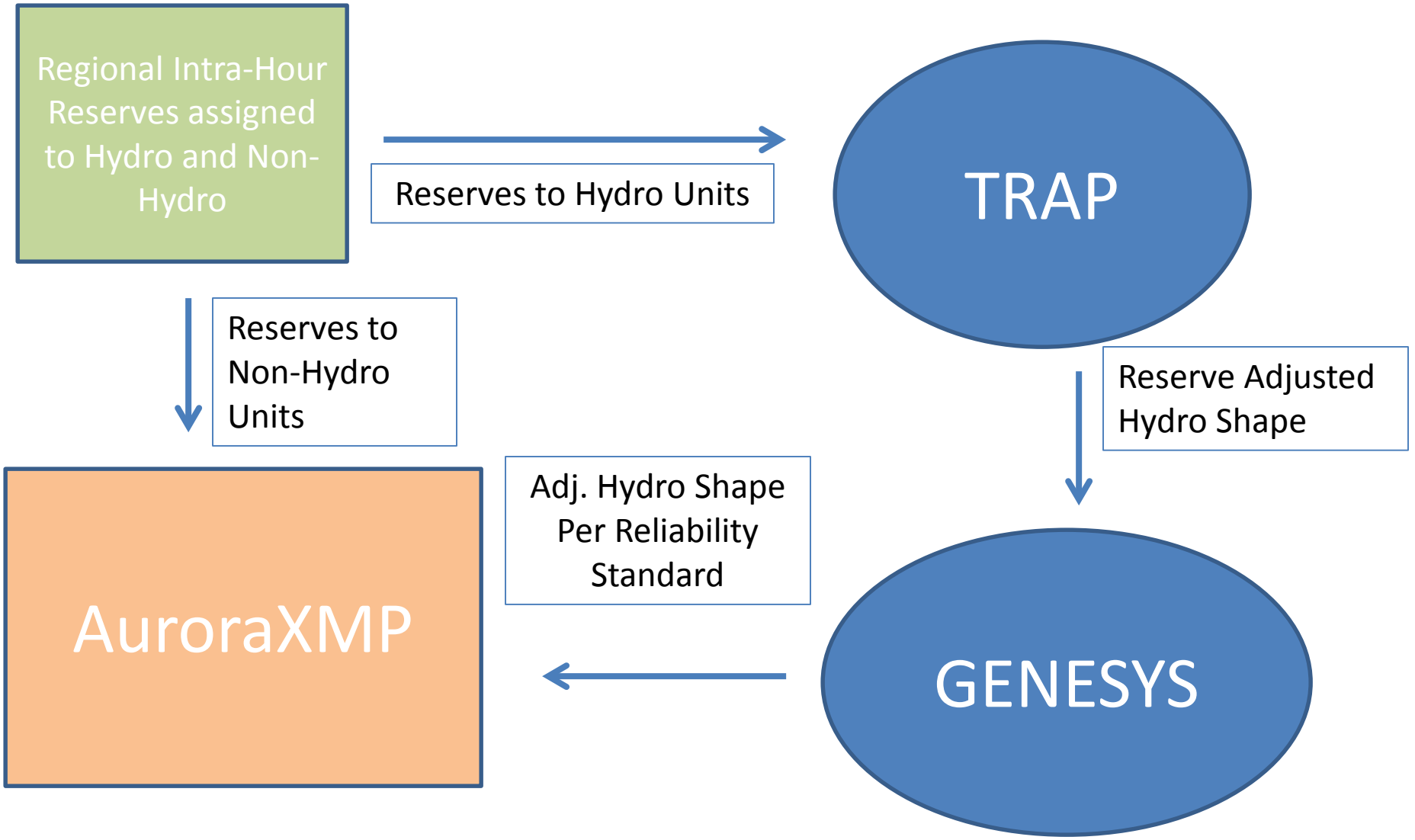
Power Committee Meeting

August 11, 2015

Review of Balancing and Flexibility Characteristics of the Power System

- Ability of the system to respond to changes in supply and demand of power both inside the scheduling time period (intra-schedule flexibility) and between multiple hours (inter-schedule flexibility).
- LSE's and wind producers must often contract for balancing services and/or hold back reserve capacity to account for intra-schedule variability when a market is not available to alleviate any supply and demand differences.
- Definitions can be varied around US because scheduling time periods are varied and different regions have slightly different definitions.

Review of Proposed Methodology



Examples of Reserve Types

- Intra-Schedule Reserves

  Operating Reserves

  – Regulation

  – Load Following

  Contingency Reserves

  – Spinning Reserves

  – Supplemental Reserves

- Inter-Schedule Reserves
  - Ramping Reserves
  - Imbalance Reserves

Determine Amount of Reserves Required by Balancing Authority

- Used the 95% Confidence Interval **load following** and **regulation** requirements for each of the 28 not generation-only BAs (Base Case for the PNNL NWPP EIM Study).
- The data set is described in more detail in the following report

  http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22877.pdf
- This is not the only dataset available, but seemed most reasonable to Council Staff based on data needs:
  1. Monthly and hourly reserve requirement data for all WECC BAs.
  2. Current regional portfolio conditions.

Assigning Reserves to Hydro/Non-Hydro Units

- Assumption:

  Total reserve requirements for each BA can be met by resources within each BA (with exception of long term Mid-C hydro Power Purchase Contracts).

- Identify resources that CAN provide reserves, and distribute reserves evenly amongst capable resources.

Range Available on Resources to Meet Reserve Requirements

- Hydro and Thermal units have a wide variety of operational capabilities including ramping, fuel supply/constraints, available transmission, and operating range of the generator.
- Since this Staff is trying to test whether the region has SUFFICIENT balancing resources, the focus will be on determining reasonable operating ranges
  - Crudely accounting for min and max generation levels, emissions constraints, etc.

Distribute Reserves Evenly Amongst Capable Resources: In Region

BA	Hydro Q1	Non-Hydro Q1
Avista Corporation	71%	29%
Idaho Power Company	70%	30%
Northwestern Montana	75%	25%
Pacificorp	61%	39%
Portland General Electric	53%	47%
Puget Sound Energy	59%	41%
BPA, Seattle City Light, Tacoma Power and other PUDs	100%	0%

Known Issues

- Reserve Distribution: In Region
  - *Based on anecdotal information in IRP's and judgment.*
- Reserve Assignment: Out of Region, in WECC
  - *Probably mostly assigned to Non-Hydro except certain BA's like SMUD that have hydro resources.*
- Seasonality
  - *In operations, reserves are probably assigned differently by season (Spring Runoff considerations, etc.). Only Winter and Summer seasonal information available in PNNL dataset.*

Next Steps

- Take balancing reserve assignment for hydro units and use TRAP and GENESYS to determine a reserve constrained hydro dispatch for AURORA.
- Input balancing operating reserve assignment for non-hydro units, hydro dispatch for 80 water years and the corresponding loads from GENESYS, into AURORA.
- Use AURORA to test the existing and potential regional portfolio for all 80 hydro/load conditions for balancing resource sufficiency.

Questions/Comments?

Operating Range Capabilities

Fuel Type	Percent of Capacity Available to meet Reserves	Reasoning Behind Proxy Assumptions
Hydro	80%	Most hydro plants have a low minimum generation and can move through almost all of their range.
Natural Gas	50%	Combined Cycle units generally have a high minimum generation from 50% to 60% on the maximum. Simple Cycle units generally have a lower minimum generation level.

Initial estimates, awaiting input from SAAC members

Convert Ranges Into Hydro/Non-Hydro Resource Reserve Assignment

- Take the capacity reserve capable units in each BA multiplied by the operating range capability percentage by fuel type, and sum hydro and non-hydro operating ranges separately.

$$Hydro\% = \frac{HydroOperatingRange}{TotalOperatingRange}$$

$$NonHydro\% = \frac{NonHydroOperatingRange}{TotalOperatingRange}$$

Capability of Current Models

- **AuroraXMP – Hourly Dispatch**
  - Limited intra-hour reserve accounting capability.
  - Extremely limited hydro dispatch capability
- **GENESYS – Hourly Dispatch**
  - Limited intra-hour reserve accounting capability.
  - Uses shapes from TRAP
- **TRAP – Hydro Shaping Algorithm**
  - Accounts for reserves held on hydro

Analysis of Aurora Dispatch

- Intra-hour reserve information input to Aurora via explicit assignment to plants and hydro shaping.
- Observing Aurora dispatch of non-hydro resources will then show how inter-hour flexibility requirements interact with economic dispatch and intra-hour flexibility.
- Complete the analysis for 80 different wind, hydro and load conditions.