

**Executive Summary**  
**PNW/CA Transmission Investigations**  
**May 2011**

**Abstract:**

The following executive summary describes study efforts that have been completed regarding the AC intertie between the Pacific Northwest (PNW) and California. Throughout this paper the AC intertie is referred to as the California-Oregon Intertie or COI. In legislation pertaining to the intertie the COI includes both the AC intertie and the DC intertie between the Dalles, Oregon and Sylmar Substation in southern California. Usage of the existing DC intertie was not considered in the studies described here.

**Summary:**

The work over the last year by the PNW and California entities has shown that there is no long term capacity available on the COI to move Canadian and PNW renewables into California. If renewable projects in the PNW are to be financed and constructed, the projects will need power purchase agreements, and in order to deliver or receive the power under the agreements, construction of additional transmission capacity into California will be needed. Construction of new projects adjacent to existing rights-of-way, and upgrading of existing transmission lines, is feasible both in the PNW and California, but will require some remedial actions in the PNW (primarily generator dropping) and reactive support devices along the routes of the projects. The price tag for this infrastructure is estimated at between \$4 billion and \$6 billion in 2010 dollars, which translates to a dollar/megawatt hour cost of between \$45/MWh and \$60/MWh for a wind renewable only project (30% capacity factor), or between \$20/MWh and \$26/MWh if the line can be loaded with all types of resources available near a 70 percent capacity factor.

An option to determine if there is any interest in the projects that have been studied, is to hold an open season process. The open season can be either a general open season or a project specific open season. A general open season process solicits interest from any entity wanting to move power from the general northwest to central California. A project specific open season would solicit interest in moving power from northeast Oregon and northeast California to the California bay area. This project would generally follow the routes that were studied by the Brownfield Options Group (BOG)

**Introduction:**

In February 2010, representatives from Western Area Power Administration-Sierra Nevada Region (Western), Pacific Gas & Electric Company (PG&E) and the Transmission Agency of Northern California (TANC) began meeting with representatives from Bonneville Power Administration (BPA) and a group of Pacific Northwest (PNW) utilities, Portland General Electric, PacifiCorp, and Idaho Power Company, to discuss the operation of the California Oregon Intertie (COI), and the status of ongoing studies to construct new transmission lines to move power from Canada and the PNW into California. The first issue the group analyzed was the perception that the COI was used underutilized (i.e. used less than 50 percent of the time), and therefore additional transmission was not needed. The Transmission Utilization Group (TUG) was formed to examine historical COI usage and determine if new transmission was needed to ensure delivery of renewable resources to California.

Based on the experience of a failed California transmission project, the preference of the new

transmission lines is to utilize existing rights-of-way to minimize environmental impacts and public resistance. The California and PNW entities agreed with this approach (Brownfield Construction) rather than using new rights-of-way (Greenfield Construction). The Brownfield Options Group (BOG) was formed to look at brownfield construction options from Northeast Oregon to the California-Oregon border. .

The TUG charter was to review the historical hourly COI scheduled usage, COI scheduling limit, COI actual flows, and unused COI capacity. From review of this data, the TUG was to determine the reasons for unused COI capacity, the time frames when the capacity was available, and the primary factors that influenced COI usage. The TUG was also to review scheduling practices associated with the COI and identify any seams issues that may cause under utilization of the COI. From these analyses, the TUG was chartered to recommend areas where opportunities existed to improve the utilization of the COI.

The BOG charter directed the BOG to investigate Brownfield routings of possible projects from northeast Oregon to the California-Oregon Border (COB) where it could meet projects using Brownfield Construction within California. The BOG was tasked to perform power flow studies of several alternative project configurations to see which alternatives performed the best, to investigate Brownfield routings utilizing existing rights-of-way that had a chance of gaining public acceptance, and to recommend alternatives for further study.

#### **Transmission Utilization Group Analyses:**

The TUG analyzed the COI usage data from June 1, 2005 through June 30, 2010, transmission reservation and scheduling timelines, and transmission rates associated with the COI. In addition, the TUG held a public COI users group meeting to elicit input about factors influencing COI usage and the obstacles preventing greater utilization. The TUG analysis determined that the COI is fully subscribed on a long-term basis and is heavily utilized during peak months. The TUG analysis also shows that the COI is frequently unavailable at the full 4800 MW rating. During the spring months (high hydro run-off), the scheduling limit on the COI was often reduced as a result of planned maintenance outages. The TUG believes that the COI owners should coordinate maintenance outages between the systems north and south of the COI as much as possible to prevent duplicate deratings. Specific conclusions of the TUG analysis are:

- Analysis of the five year usage data indicates that the price spread between the PNW's Mid-C trading hub and California's NP15 trading hub is the most significant driver for the usage of the COI. As the price spread between the two hubs increases, COI usage increases until the scheduling limit is reached.
- COI transmission capacity (north to south) is fully subscribed on a long-term basis and there is no additional long-term transmission capacity available for users.
- COI utilization varies significantly year-to-year depending on seasonal and market factors. Variability in the hydro run-off in terms of volume, shaping, and duration, produce vastly different yearly profiles. Similarly, monthly variability in the summer months is driven by California load resulting from higher temperatures.

Based on these findings, the TUG reached the following conclusions regarding the potential for increasing COI transmission availability and usage:

- Entities that need firm delivery will require new transmission capacity.

- New long-term transmission capacity would allow the generators and California utilities to enter into power purchase agreements, obtain financing, and have certainty of power deliveries.
- PNW and California entities should cooperate, and consider moving forward with an Open Season process to determine the demand and interest for additional transmission.

#### **Brownfield Options Group Analyses:**

The BOG analyzed four alternative projects using various Brownfield routings from British Columbia to northern California. Each of the alternatives assumed an additional 3000 MW would be scheduled to northern California; 750 MW from British Columbia, 1250 MW from the PNW, and 1000 MW from northeast California and northern Nevada. The studies performed used a 2015 Heavy Summer base case to judge incremental performance. In order to determine line mileage to properly model the alternative project impedances, routings were assumed to be built in rights-of-way adjacent to existing transmission lines. Some of the routings investigated along existing lines would create access problems and/or public acceptance problems because of the number of transmission lines in the corridor.

The alternatives were various mixes of AC transmission lines, DC transmission lines, and conversion of an AC transmission line to DC from NEO (a new substation in northeast Oregon) to central California. These alternatives also assumed that upgrades to transmission lines, or new transmission lines within or adjacent to existing rights-of-way within California would be undertaken. These lines would form parallel paths for flows on the circuits from NEO to northern California if the main DC line blocked or was forced out of service. Essentially, the transmission lines within California would mitigate for outages without requiring extensive generator dropping in the PNW.

The findings of the BOG are:

- All of the options studied perform well under the assumed incremental power flows into California
- One of the options, however, caused the most overloading in the underlying system for outages of the alternative project, and should be eliminated for further study
- Based on the study results, three of the four options are recommended for further study.

Specific recommendations from the BOG are:

- Engineering, land, and additional power system studies are recommended for the remaining three alternatives
- The engineering study would identify potential tower line configurations, constructability analyses, and maintenance procedures
- The land study would consist of assessing whether there are environmental/land constraints that might preclude a particular option or Brownfield alignment, and identifying right-of-way requirements
- Future power system studies should analyze power flow, transient stability, and voltage stability with both north to south and south to north transfers.

#### **Preliminary Cost Estimates:**

Due to the changing nature of California's Renewable Portfolio Standards rules regarding in-state and out-of-state renewables, Tradable Renewable Energy Credits, and definition of these terms, the preliminary cost estimates have been derived for projects with a 1500 MW, 2000 MW, and 3000 MW transfer capability. These estimates range from about \$4 billion for a 1500 MW project to about \$6 billion for a 3000 MW project. If these projects were limited to renewables only at an average annual capacity factor of about 30 percent, the dollar per megawatt hour cost translates to a range of between \$45/MWh to \$60/MWh not counting losses. Even if the projects could be loaded to an average annual capacity of 70 percent, these volumetric costs range from \$20/MWh to \$26/MWh.

#### **Participants in the Study Efforts:**

##### **Pacific Northwest**

Bonneville Power Administration  
Portland General Electric  
PacifiCorp  
Idaho Power Company  
Avista  
BC Hydro

##### **California**

Western Area Power Administration – Sierra Nevada Region  
Pacific Gas & Electric Company  
Transmission Agency of Northern California  
California Independent System Operator Corporation  
Sacramento Municipal Utility District