PACIFIC NORTHWEST/CANADA - NORTHERN CALIFORNIA

Transmission Feasibility Study

Technical Analysis Committee Study Plan

Preliminary Draft

January 10, 2007
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Appendix 1 Conceptual Schematics for Transmission Options
1. Objective

PG&E is embarking on the WECC Regional Transmission Planning Review process to study the feasibility of building a bulk power transmission facility from the Pacific Northwest and Canada to Northern California. The purposes of this regional planning review process are:

- Evaluate transmission alternatives to access renewable and other resources in the Pacific Northwest, British Columbia and Alberta.
- Determine the benefits and costs of such alternatives.
- Seek stakeholder input on the analysis and scope of the project alternatives.

As a part of the WECC regional planning review process a number of studies, such as a) technical feasibility, b) economic feasibility and c) environmental feasibility are required to assess the impacts of the proposed transmission path.

The objectives of the technical study plan are to:

- Identify a preliminary plan of service for the construction of a transmission path from Canada/ Pacific Northwest to Northern California with a potential capability of importing up to 3000 MW of renewable and other resources to Northern California.
- Develop preliminary path ratings for the proposed facilities.
- Determine interactions with existing WECC paths.

The preliminary plan of service shall be flexible and scalable depending upon development of renewable or other resources along the proposed transmission path. The on-line date of service for any such bulk power transmission facility is expected to be no earlier than 2013.

Transmission project corridors that are being considered for this study consist of East Side and West Side options as shown in Appendix 1-Fig 1. These options are discussed in the following section.
2. Transmission Options

East Side Options

1) A 500 kV AC double circuit transmission line from Selkirk-British Columbia to Northern California. (Appendix 1-Fig 2)

- Northern Termination - Selkirk BC Canada
- Termination in California
  - Table Mountain/Round Mountain or
  - Rio Oso/Elverta/OBanion or
  - Bellota/Rancho Seco
- En Route terminals
  - Lower Monumental 500 kV station - Washington State
  - Burns 500 kV station - Oregon
  - Border Town or a new station close to Nevada/California border

2) 500 kV transmission line from Selkirk-BC and a 500 kV line from Eastern Nevada and beyond to terminals in Northern California (Appendix 1-Fig 3)

- Northern Termination - Selkirk BC Canada
- Eastern Termination – To be Determined
- Termination in California
  - Table Mountain/Round Mountain or
  - Rio Oso/Elverta/OBanion or
  - Bellota/Rancho Seco
- En Route terminals
  - Lower Monumental 500 kV station - Washington State
  - Burns 500 kV station - Oregon
  - Border Town or a new station close to Nevada/California Border
3) **765 kV Single Circuit Transmission Line (SCTL) from Selkirk-BC and a 500 kV line from Eastern Nevada and beyond to terminals in Northern California** (Appendix 1-Fig 4)

- Northern Termination - Selkirk BC Canada
- Eastern Termination – To Be Determined
- Termination in California
  - Table Mountain/Round Mountain or
  - Rio Oso/Elvera/OBanion or
  - Bellota/Rancho Seco

- En Route terminals
  - Lower Monumental 500 kV station - Washington State
  - Burns 500 kV station - Oregon
  - Border Town or a new station close to Nevada/California Border
  - Others?

**West Side Options**

3) **500 kV DC submarine cable from Oregon to San Francisco with a target capability of 1600 - 2000 MW.** (Appendix 1-Fig 5)

Consists of two +/- 500 kV DC submarine cables with DC terminals each at:

- Allston Oregon
- Martin SF Bay Area and
- Newark SF Bay Area

- Same as the West Coast Cable (WCC) option which was studied by PG&E Company and Sea Breeze Corporation under the MOU in 2005-2006.

- Sea Breeze Corporation has announced the commencement of WECC Phase 1 Rating Process for the WCC project.
Results of the Phase Rating study to be included in the Regional Planning Review Report

For this DC Submarine cable option assumption on system reinforcements north of Allston substation along the I5 corridor in Pacific Northwest and reinforcements on the BCTC system to access the renewable resources in British Columbia will be made. As an example this could be the proposed Juan De Fuca cable project or new AC transmission line from Allston to Nicola Substation in British Columbia.

For all the options proposed in this study plan, while the system impacts will be considered in determining the preferred terminations and intermediate station points, a thorough analysis of potential system interactions throughout the WECC will be addressed as part of the WECC rating process. However as a part of the regional planning review process for the project, limited analysis will be carried out to establish preliminary ratings (non simultaneous flow) for the options studied. In addition, a limited set of conditions will be studied to establish interaction with the existing paths (simultaneous transfers), including BC-Washington (Path 3), North of John Day (Path 73) COI (Path 66), PDCI (Path 65).

3. Study Assumptions

This study will include the following assumptions:

1) The expected on-line date of the transmission options is 2013.

2) The load and resource scenarios developed by the Load and Resources Committee will be one of the inputs in the technical analysis.

3) The technical requirements for interconnecting generation resources in particular regions identified by the L&R Committee will be determined by the local transmission entities\(^1\) to which the renewable or other resources are planning to interconnect. The local transmission entities will identify the system impacts and cost of generation interconnection and submit this information to the Technical Analysis Committee and Economic Analysis Committee.

4) In order to simulate import of 3000 MW of capacity to Northern California from Canada and the Pacific Northwest, generation resources and the loads

\(^1\) For the renewable resources located in British Columbia, BCTC would provide transmission requirements and cost to interconnect to the BCTC grid, similarly for resources located in Washington state, Oregon and Nevada, PacifiCorp, Sierra Pacific or other local transmission entities would provide the interconnection requirements and cost to interconnect to the local grid.]
served along this transmission path will re-dispatched such that desired transfer levels are achieved on the transmission option being evaluated.

5) Depending upon the renewable resources\(^2\) being dispatched to accommodate the energy transfers to California from Canada and the Pacific Northwest on the proposed transmission paths, additional generation may be dispatched in Canada or Pacific Northwest for regulation purposes.

6) This study will take into account all WECC transmission reliability projects that have the WECC Phase II approval and that are scheduled to be operational by June 2013.

7) Selected WECC paths\(^3\) within the study area will be monitored and adjusted close to their rated value and be within applicable operating nomograms. The technical studies will determine the impact of a 3000 MW import into northern California and export of 2000-2300 MW from California to Pacific Northwest and Canada on the existing and proposed (in Phase 2) paths. The actual path rating for any new transmission facility would be defined in its WECC Phase I and II Rating Review Process.

8) Northern California entities will develop conceptual transmission plans for the delivery of import along the proposed transmission paths to the load centers in Northern California. As an example PG&E will develop conceptual transmission plans to deliver the imports from the southern termination such as Table Mountain or Rio Oso or Bellota to a new 500 kV station with step down transformers in the San Francisco Bay Area.

4. Study Base Cases

While it is impossible to study all combinations of system load and generation dispatch levels during all seasons and at all times of the day, power flow base cases representing extreme loading and generation conditions for the study area will be evaluated for each of the transmission options. The two loading conditions one representing North to South transfers and the other South to North transfers will be considered for evaluation.

Two base cases will be prepared to evaluate the potential impacts of the transmission options. A Summer Peak case representing high North to South transfers and a Winter Peak case representing South-North transfer will be considered in this study. In both cases the existing and potential DC and AC ties will be modeled.

In addition to these two base cases, sensitivity to spring partial peak conditions representing high hydro level dispatch in Pacific Northwest and Northern

\(^2\) The renewable resources could be wind, geothermal, solar, small hydro, et. al.

\(^3\) Major WECC paths for this study are Path 66(COI), Path 26, Path 15, West of Borah, PDCI, and North of John Day.
California coupled with high North-South transfers may also be evaluated for each option.

- **2016 Heavy Summer Peak Base Case:**

Power flow analysis will be performed using WECC 2016 Heavy Summer Peak base case (16HS1A1). The Base Case will be modified to accommodate the study option and expected import on the proposed transmission facilities. This case will model maximum imports into Northern California from COI, the PDCI, and the proposed transmission line option.

- **2015 Heavy Winter Peak Base Case:**

Power flow analysis will also be performed using the WECC 2015 Heavy Winter case (15HW1A1). The Base Case will be modified to accommodate the study option with potential for exporting additional\(^4\) 2000-2300 MW to Pacific Northwest and Canada on the proposed transmission facilities. This case will model maximum imports into northern California from path 15 and Path 26, and maximum exports from California to the Pacific Northwest and Canada.

### 5. Study Scope

The technical studies will determine the impact of a 3000 MW (1600-2000 MW for the DC submarine cable option) import on the WECC regional transmission system. The study will also determine the impact of additional 2000-2300 MW south to north transfer capability for the AC transmission options considered in this study plan on regional transmission system. Remedial Action Schemes (RAS) which drop generation in Canada and the Pacific Northwest and load in Northern California will be considered in this study. The following studies will be carried out to determine the system impacts of the transmission alternatives.

#### 5.1 Power flow Study

Power Flow or Governor Power flow analysis will be performed\(^5\) for select transmission contingencies using the two base case scenarios described above. The two base cases will be used to simulate the impact of the transmission options for the following conditions:

\(^4\) The present South to North transfer limit at COI is 3675 MW.

\(^5\) For the transmission alternatives considered in this study plan, each transmission owner [here, “transmission owner” is not a defined term, as it is in the ISO Tariff; in fact, NOT using initial caps places at least a little distance between this study process and the ISO, and that is a good thing] will identify and perform the [is it “the” or “a”?] Power Flow or Governor Power Flow and Transient Stability Study on select 500 kV and critical 230 kV facilities on their systems.
1. Category A - Normal operating conditions.

2. Category B - Select single element outages of existing system including the transmission alternatives.

3. Category C - Selected multiple facility outages of existing system including the transmission alternatives.

The Technical Analysis Committee will advise and perform necessary studies on selected contingencies. Where applicable, the Remedial Action Schemes (RAS) which may include generation and load dropping will be simulated. If necessary, new RAS schemes for the alternatives studied will be proposed, for example the outage of a transmission option may require dropping of generation resources connected to the northern terminal and load connected to the southern terminal and intermediate substations.

5.2 Dynamic Stability Analysis

Dynamic stability analysis will be performed to evaluate the system performance of the bulk power transmission system with each transmission alternative to ensure they meet the WECC Planning Guidelines. Dynamic stability studies will be conducted to ensure that the transmission system remains in operating equilibrium through abnormal operating conditions after the transmission alternative is in operation. Disturbance simulations will be performed for a study period of up to 20 seconds to determine whether the transmission alternative would create any system instability during and following the line and generator outages.

5.3 Reactive Margin Analysis

The reactive power required at selected substations will be determined by adding shunt capacitors sufficient to avoid voltage collapse of the transmission system impacted by additional import from the proposed transmission path. Dynamic and post transient voltage stability will be determined based on this pre-outage level of reactive support. Governor Power flow model will be utilized to carry out this analysis.

5.4 Land Evaluation

Because all the transmission alternatives to be considered in this study involve interstate routes, the potential routes for the interconnection alternatives will be evaluated jointly by participating transmission entities in the Regional Planning Group. This will include an evaluation to determine if any new land rights would be necessary, species habitats, and environmental issues. Independently PG&E is evaluating possible transmission routes between Canada and Northern California, the results of this evaluation when complete may be utilized in the refinements of the alternative presented in this study plan.
5.5 Engineering Cost Estimate

For the transmission options considered in this technical analysis, a high level cost estimate will be developed for transmission lines, substation additions and for other system enhancements that may be identified in this study. The cost estimates will be based on unit cost. The cost estimate for the options will be provided to the Economic Analysis Committee.

6. Study Schedule

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Appendix 1

Conceptual Schematics for Transmission Options
Figure 1: Proposed Transmission Corridors
Figure 2: A 500 kV Double Circuit Tower line from Selkirk to Northern California
Figure 3: A 500 kV line from Selkirk and 500 kV Line Eastern Nevada to Northern California
Figure 4: A 765 kV Line from Selkirk and 500 kV Line from Eastern Nevada to Northern California
Figure 5: DC Submarine Cable from Oregon to San Francisco Bay Area