Proposed Presentation Outline

Intermittency Analysis Project (IAP)
Energy Commission Staff Workshop

August 15, 2006
Hearing Room A

I. Welcome, Introductions, Project Status and Schedule 9:00 – 9:30

Kevin Porter, Exeter Associates and Dora Yen, CEC

A. Team Introductions
B. Project Goals
C. Project Status
D. Schedules

II. CA ISO Perspective on Transmission Planning 9:30 – 10:00

Dariush Shirmohammadi, Director of Regional Transmission, CA ISO

A. Update on CaISO Transmission Planning activities, sub-regional work
B. Perspective on long-term transmission and impact of renewables on operational issues

III. Transmission Simulations - Methods and Results 10:00 – 12:15

Ron Davis, Davis Power Consultants
Scott Dahman and Kollin Patten, PowerWorld Corporation

A. Motivations
B. Overview of Power Flow Model
C. Transmission Analysis and Review of Terminology
    1. Development of Renewable Transmission Benefit Ratio (RTBR)
    2. Transmission constraint analysis approach
        a. Constraint and congestion mitigation
        b. Load and generation (maps)
        c. Locating resources based on benefit and impact
        d. Common basis for evaluating renewable and conventional generation resources
D. Analysis Objectives
    1. 4 Scenarios for evaluating penetration (2010 – 20% and 2020 – 33%)
    2. Study impacts of increasing renewable penetration on transmission system reliability
    3. Determine critical modeling issues for projecting long range transmission plans and operations
    4. Analyze power flows results to support production cost modeling
E. Establishing Baseline – 2006 Existing Renewable Resource
    1. Preparation of Data Set (sources, assumptions, verification, resolution)
        a. Data sources, verification and assumptions

b. Incorporate additions, retirements, other upgrades (CEC projections)
c. Load forecasts (growth and locations)

2. Review of Existing Renewable Mix
   a. Map of resources by technology
   b. Map of connection locations
3. Results of Statewide RTBR Analysis
   a. Benefit ratios of existing renewables and locations
   b. Intermittency impacts of baseline
   c. Baseline transmission system impact results
   d. Baseline issues and problems (VAR, voltage, transmission constraints)

F. 2010 Scenario Development and Rationale
   1. Building the Data set for 2010
      a. Assumptions and projections (sources, data)
      b. Incorporate additions, retirements, other upgrades (CEC projections)
      c. Load forecasts
      d. 2006 and 2010 variations
      e. Seasonal variations
   2. Summer, Spring, Fall power flows study cases
   3. 2010 20% Scenario includes Tehachapi 3000 MW
   4. 2010 Transmission Congested

G. 2010 - 3000 MW Tehachapi Case Results
   1. Renewable resource portfolio mix (maps, tables)
   2. Planning reserve margin modeling
   3. Review and comparison of RTBR results
   4. Transmission system impacts and fixes to accommodate 2010 levels

H. Findings and Recommendations

IV. Lunch **12:15 – 1:15**

V. Projected Impacts of the 2010 Scenario **1:15 – 4:00**

GE Energy Consulting: Richard Piwko, Nicholas Miller, Gary Jordan

A. Overview
   1. Production cost modeling & link to power flow – analysis timeframes
   2. Definition of intermittent (variable) generation resources
   3. Objectives
      a. Evaluate impact on operations with increasing levels of intermittent renewables
      b. Identify and quantify system performance and operation problems (load following, regulation, minimum load, peak)
      c. Identify and evaluate possible mitigation strategies

B. Four proposed scenarios to be analyzed
   1. 2006 Base Case
   2. 2010 Tehachapi Case – 20% Renewables
   3. 2020 case with 33%

4. Higher penetration level

C. Details on 2006 and 2010 Tehachapi scenarios
D. Types of analysis included in the project
    1. Statistical evaluation
    2. Production cost simulation (MAPS)
    3. Quasi-steady-state simulation
    4. Transient simulation
E. Data used for production cost modeling study
    1. Powerflow datasets from DPC
    2. Load data from CAISO (hourly and 4-second)
    3. Wind data from AWS Truewind (hourly and 1-minute)
    4. Solar data from variety of sources
F. Statistical Analysis of 2006 and 2010 Tehachapi Scenarios
    1. Overview of analytical methodology (flowchart)
    2. Examples of temporal, seasonal, and spatial variations for wind and solar generation (load, wind, and solar MW vs time, highlight Tehachapi area)
G. Statistical Analysis of 2006 Scenario
    1. Load duration curves with and without wind and solar
    2. Plots of maximum load, minimum load and load minus wind and solar
    3. Statistics showing hourly variation, with and without wind and solar
H. Statistical Analysis of 2010 Tehachapi Scenario
    1. Load duration curves with and without wind and solar
    2. Plots of maximum load, minimum load and load minus wind and solar
    3. Plots showing wind and solar penetration as a function of load
    4. Statistics showing hourly variation, with and without wind and solar
I. Statistical Analysis: Search for Extremes
    1. Summary of selected extreme periods from 2002-2004 profiles
        a. Largest 3-hour and 1-hour changes (load MW, wind and solar)
        b. Highest and lowest load periods, penetration
    2. Load-duration curve showing “locations” of selected extreme periods
    3. Plots showing 24-hour load, wind, solar profiles for selected periods
J. Statistical Analysis: Intra-hour Variability
    1. Overview of methodology to quantify 5-minute variability (load-following)
    2. Overview of methodology to quantify 1-minute variability (regulation)
    3. Tables comparing results for 2006 and 2010 Tehachapi scenarios
K. Statistical Analysis: Forecast Errors
    1. Plots showing forecast and actual load, wind, solar MW for a representative week
    2. Duration curves of forecast errors
    3. Plots showing max/min extremes and standard deviations of forecast errors
L. Production Simulation Analysis
    1. Overview of analytical methodology (flowchart)
    2. Production simulation results for 2010 Tehachapi scenario

a. Operation with no wind or solar forecast
b. Operation with perfect wind and solar forecast
c. Operation with "state-of-the-art" wind and solar forecast

3. Additional cases with no new wind and solar generation (for comparison
4. Additional cases with no new wind, solar, biomass, geothermal (for comparison)

M. Plots illustrating impact of new renewables on statewide generation mix
N. Observations and Conclusions from Results-To-Date
    1. Observations on unit commitment
    2. Observations on forecasting
    3. Observations on possible load following and regulation impacts

VI. Discussion and Q&A – All **4:00 – 4:45**

A. Input on 2020 33% penetration scenario and higher penetration scenario?
    1. Are current values and locations representative?
    2. Are there other areas to consider?
B. Perspectives on regulatory and market considerations?
C. Perspective on sub-regional planning needs?
    1. Difference in resource mix by utility area
    2. Suggestions on mitigation strategies
    3. Lessons learned

VIII. Next Steps and Adjourn **4:45 – 5:00**

Kevin Porter and Dora Yen