Transmission Planning as Practiced by WAPA & Bonneville Administration

BLM Transmission Training
Webinar Series

Webinar 3

January 30, 2012
MAP Pending High Voltage Lines
AGENDA
January 30, 2013

- NERC/FERC
- WAPA Annual Planning Process
- Line Separation
- TOT3 Example
- Questions
• NERC/FERC
Electric Industry Recent Rulings

- Orders 888/889 – Separate Gen/Transmission; OASIS Postings
- Energy Policy Act of 2005
- FERC – Authority to Manage the ERO (NERC) who in-turn manages the RROs (WECC, MRO, SPP)
- Order 890 – Open Stakeholder Involvement
Electric Industry Recent Rulings

• American Recovery and Reinvestment Act of 2009

• Order 1000 – More Inclusive Planning Process; Cost/Benefit Analysis; Cost Allocation on both Intra- and Inter-Regional Basis
WestConnect Subregional Planning Groups

CCPG, SSPG and SWAT are technical planning work groups within the WestConnect Footprint

• Coordinate Information for use by all study participants
• Define subregional study plans, provide study resources, and perform studies
• Provide forum for coordination and peer review of planning studies and 10-year plans
• Agree on inter- and intra-Regional Projects and have a Cost Allocation process
NERC Planning Standards - TPL

Ten Year Seasonal Cases

- NERC Category A
- NERC Category B
- NERC Category C

Analyze Against Criteria

- Bus Voltages
- Change in Bus Voltages
- Power Flow

Results
• WAPA 10-Yr Transmission Study Timeline
Study Timeline

- **February 1**
  - Send 10YR load forecast request to all network customers
  - Request submittal by March 15

- **March 15**
  - 10YR load request responses due.

- **March 15 – June 15**
  - Conduct annual study

- **July 31**
  - Annual report due to J5640

- **July 31 – November 30**
  - J5640 develops preliminary project scope and budgetary estimates for inclusion in CIP

- **November 30**
  - J5640 to incorporate projects into the CIP (10YR Plan Report)

Load Forecast Data Example

<table>
<thead>
<tr>
<th>TOWN OR BUS NAME</th>
<th>Bus Number</th>
<th>Company Meter Name</th>
<th>Western Meter Name</th>
<th>2009 Summer</th>
<th>2009-10 Winter</th>
<th>2010 Summer</th>
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<tr>
<td>AAAA</td>
<td>#######</td>
<td>ABCD</td>
<td></td>
<td>5,100.00</td>
<td>0.00</td>
<td>5,300.00</td>
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<td>BCDE</td>
<td></td>
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<td>#######</td>
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<td>2,000.00</td>
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<tr>
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<td></td>
<td>4,378.65</td>
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Study Process

- **Stress**
  - TOT3 1739 MW
  - TOT5 874 MW
  - YTS 628 MW

- **No Stress**
  - Loads modified without topology changes

- **Stress**
  - TOT3 1692 MW
  - TOT5 1056 MW
  - YTS 618 MW

- **Stress**
  - TOT3 1710 MW
  - TOT5 642 MW
  - YTS 626 MW

- **2015 HA**
- **2017-22**
- **2017 HS**
- **2022 LS**
RMR North Recommendations

- **Basin-Nahne Jensen 115 kV Line Record**
  - $2,500,000
  - 106% load of norm/emerg. rating during YT-YTPACE N-1.
  - Case History: 2015-2016-2017
  - 2009-part of YTS Transfer Project 2010-Removed 2012-confirmed N-1 thermal issue sensitivity study may alter scope.

- **Poncha 30 MVAR Reactor**
  - $500,000
  - 230 kV system history of high voltage during light loading; studies @ 1.067 pu. Project may be provided by PSCO.
  - Case History: 2015-2017-2022

- **Sidney 230/115kV Xfmr Joint Study**
  - Loss of TSGT’s Sidney 230/115 kV transformer results in 6-10% voltage deviation on area 115 kV system; Joint study with TSGT recommended.
  - Case History: 2015-2016-2017

- **Big Horn Basin Sensitivity Study**
  - 69 and 115 kV reactive support needed; thermal overload on 115 kV system. Sensitivity study to determine long term, low cost solution for the Big Horn Basin Area.
  - Case History: 2015-2016-2017
Capacity Adequacy Analysis

• Performed by the Transmission Business Unit

• Incorporated into the Ten Year Study as a means to identify transmission capacity issues that impede the commercial viability and efficient operation of the Western Transmission Network
CAA Results

• Several Significant Path Constraints Identified including:
  - Craig-Bonanza (CRCM)
  - Dave Johnston-Ault (LAPT)
  - Four Corners area from the South (Southern CRSP)
  - Paths into CA from AZ
- Line Separation
Typical 500-kV Transmission Structure
“Minimalist” Separation Distance

260 feet line
separation distance

~60 feet
~170 feet
~170 feet
~30 feet
"Span-Length" Separation

1500 feet line separation distance

~60 feet

~170 feet

~30 feet
No “One-Size Fits All”

• Reliability Perspective – Further Apart to Minimize Possible Simultaneous Outages

• Further Apart – Land Use/Environmental

• Public/Stakeholder Input

• State/Regional/National Interests
No “One-Size Fits All”

- Redundancy Leads to more Stable Network
- One-Span Length Cuts down the Probability of a Wire being Swung from One Circuit to the Other
- Terrain – Mountainous vs. Farmlands
- NEW WECC Business Practice - Need 250’ Separation to Consider Separate for Fault Simulations
• TOT3 Example
### TOT-3 TTC/ATC Calculations

<table>
<thead>
<tr>
<th>TOT3 Ownership</th>
<th>Capacity</th>
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<tbody>
<tr>
<td>MBPP – 70.5%</td>
<td>1132</td>
</tr>
<tr>
<td>Western – 24.93%</td>
<td>475</td>
</tr>
<tr>
<td>T. State – 0.83%</td>
<td>13</td>
</tr>
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<td>PSCo – 3.74%</td>
<td>60</td>
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<p>| | |</p>
<table>
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<tr>
<th></th>
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<td></td>
<td>1680</td>
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</table>
TOT3 MAJOR LINES

- 345KV
- 230KV
- 115KV

- TOT3
- AULT
- ARCHER
- LRS
- STEGALL
- SIDNEY
- COLORADO
- WYOMING
- NEBRASKA
- N.YUMA
- PAWNEE

- 400 MW
- 700 MW
LOADs to 100%

OUTAGE!

1000 MW

LOW VOLTAGE

0 MW

TOT3 MAJOR LINES

345KV
230KV
115KV

G

AULT

ARCHER

WYOMING

NEBRASKA

COLORADO

N.YUMA

STEGALL

SIDNEY

PAWNEE

TOT3

30
TOT3 MAJOR LINES

- 345KV
- 230KV
- 115KV

OVERLOAD/INSTABILITY

OUTAGE!

LOW VOLTAGE

1200 MW

0 MW

TOT3

AULT

ARCHER

LRS

STEGALL

SIDNEY

COLORADO

NEBRASKA

WYOMING

N.YUMA

PAWNEE

STORY
QUESTIONS?
Western Area Power Administration

Transmission Infrastructure Program

Presented to: BLM Webinar
Implement Title III Hoover Power Plant Act 1984
(under American Recovery and Reinvestment Act)

Borrowing authority of $3.25 billion

Identify, prioritize and participate in the study, facilitation, financing, planning, operating, maintaining, and construction of new or upgraded transmission facilities
TIP MILESTONES

- Feb 2009: Western receives TIP borrowing authority from congress
- March 2009: Western published a “Notice of Availability of Request for Interest” in Federal Register
- April 2009: Western chartered a Sr Mgt and Transmission Planning team to evaluate over 200 statements of interest from potential project sponsors.
- Oct 2009: TIP names Program Manager and begins staffing
- TIP is transitioning from start up phase to permanent phase
- TIP remains open to new solicitations from Project developers.
TIP Optimization
Based on Continuous Improvement

• Evaluate the Program project development process
• Evaluate existing criteria for screening and prioritizing potential Program projects
• Increase the transparency of the vetting process for potential Program projects and
• Improve communications with Program applicants
TIP PROGRAM PRINCIPLES

- Projects must have one terminus within area served by Western
- Deliver, or facilitate the delivery of, power generated by renewable energy resources to be constructed or reasonably expected to be constructed
- Encourage broad-based participation
- Uses Project revenue as the only source of revenue for:
  - Repayment of loan for project
  - Payment of ancillary service and O&M expenses
- Maintain controls for accounting and repayment - projects under this authority are separate and distinct
- Ensure project beneficiaries repay project cost
- Must be in the Public Interest
- Must not impair system reliability or statutory obligations
- Have reasonable expectation of repayment of principal and interest of Treasury loan and associated project costs on a stand alone basis – costs cannot be integrated into existing projects
- Use a public process to set rates for new facilities
- Must independently obtain and arrange for the delivery of generation-related ancillary services
Projects under consideration for TIP funding must:

- Facilitate the delivery to market of power generated by renewable resources constructed or reasonably expected to be constructed.
- Have at least one terminus located within Western’s service territory.

In addition, project evaluation includes feasibility of developing a project that meets the following criteria:

- Provides economic developmental benefits, including an estimate of how many, the type, how fast, and where in the country jobs are created.
- Gives priority to projects that satisfy Western’s Open Access Transmission Tariff (OATT) or related requests.
- Addresses the technical merits and feasibility of a project.
- Financial stability and capability of all potential project partners.
- Project readiness (e.g., permitting, local, state and/or regional approval).
- Project partners’ participation in a region-wide interconnection-wide planning group or forum.
TIP PROJECT MODELS

• Financier model
  • Construction financing
  • Construction – Long-term financing
  • Western owns capacity
  • Example Project – Montana Alberta Tie Limited (MATL)

• Public-Private Partnership model
  • Partnership with Merchant Transmission Developer
  • Western uses borrowing authority to finance ownership in Project
  • Example Project - TransWest Express Transmission Project (TWE)

• Western internal transmission projects
  • Partnership with Western Regional office to add or upgrade needed transmission identified typically through 10-year planning process.
  • Example Project - Electrical District 5-Palo Verde Hub Project (ED5-PVH)
NEGOTIATING WITH DEVELOPERS

- Upon selection of SOI, Project Developers favoring Advanced Funding Agreements.
- TIP brings the following to the transaction:
  - Siting, Scoping and Permitting expertise for Environmental process approvals
  - WECC path rating expertise in terms of managing studies and process
  - Experience with Interconnection Agreements
  - Design expertise for transmission lines and sub-stations
  - Construction management and Quality Assurance for EPC
  - Financial structuring and project financing
  - Operations and maintenance capability
  - TIP Borrowing authority
  - Experience with Regulatory issues
EXAMPLE OF TRANSACTION STRUCTURE

- Other Investors
- Project Developer
- Western Area Power Administration
- TIP Borrowing Authority
- Private Lending Facility
- Joint Ownership Agreement
- EPC & O&M Contracts
- Finance Agreement(s)
- Project Special Purpose Vehicle LLC
- WAPA
- EPC
- O&M
- TSR for Transmission capacity
- PPA for Generation Capacity
- Other Investors
- Project Developer
- Western Area Power Administration
- TIP Borrowing Authority
- Private Lending Facility
- Joint Ownership Agreement
- EPC & O&M Contracts
- Finance Agreement(s)
- Project Special Purpose Vehicle LLC
- WAPA
- EPC
- O&M
- TSR for Transmission capacity
- PPA for Generation Capacity
UNDERWRITING REQUIREMENTS

• A solid business plan and Project operating plan
• Financing and commercially-sound project producing adequate cash-flow to:
  • Pay all operational costs
  • Service all debt
  • Provide owners with reasonable rate of return
• Track record of success on similar projects
Finally, Western’s Administrator must certify, prior to borrowing funds from Treasury, that each project:

- Public interest nexus
- No adverse impact to system reliability or operations, or other statutory obligations.
- Reasonable expectation that the project will generate enough transmission service revenue to repay the principal investment; all operating costs, including overhead; and the accrued interest by the end of the project’s service life.
Western Contacts

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Overview of Transmission Planning

Anders Johnson
Bonneville Power Administration
Long Term Planning
Basics of Electric Transmission

• Alternating Current (AC) vs. Direct Current (DC)
• Generation and load must always be balanced
• Higher voltages used to move power long distances
• AC flows are closely monitored but difficult to precisely control
Drivers for New Transmission

• Load Growth
• New generators
  – Renewables
  – Dispatchable capacity
• Changes in asset utilization
  – Generator retirements (High emission coal)
  – Oversupply in some areas vs. shortages in others
• Open Access Transmission Tariff (OATT) requests
Transmission Planning Considerations

• NERC/WECC Transmission Planning Standards
  – Deterministic: System must withstand all credible single and common mode contingencies without violating performance requirements
  – Thermal overload, voltage stability, transient stability

• Integrated Resource Planning
  – Probabilistic: Must have enough transmission capacity to deliver generation to reduce loss of load probability
  – Production cost analysis
  – Transmission congestion increases cost to customers
Example: Line Outage

Before

P \downarrow
\frac{1}{2} P \downarrow
\frac{1}{2} P \downarrow
P \downarrow

Generator
Transformer
Substation
Transmission Lines
Substation
Transformer
Load

After

P \downarrow
P \downarrow
P \downarrow

Load
Capacity Increase Options

• Incremental upgrades: Push more power through existing lines
  – Substation equipment (capacitors, transformers, circuit breakers)
  – Increased line rating (increase clearance to ground, replace conductor)
  – Control actions

• Build a new line
  – Sometimes the only technically feasible option
  – Rebuild existing line to higher capacity, build next to existing corridor, or build in new corridor
  – Lumpy
Additional Considerations

• Is project feasible to permit?
• Available Transfer Capacity
  – Commercial allocation of capacity
  – Firm vs. Non-firm
  – Need capacity all the way from generation to load, not just across monitored elements of a path
• “Too Big to Fail” Problem
  – Must plan for outages of double circuit, adjacent circuit, and HVDC lines
  – Double circuit does not always provide double the usable transfer capacity as single circuit
Questions?