

CTPG's Draft Phase 3 Study Report

Presentation to
RETI Stakeholder Steering Committee
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Scenario: RETI-BC_Asn

- **Objective:** Study high south-to-north flows on Path 15
- **Load:** No. CA 1-in-10 July peak load
- **Renewable Additions:** RETI “Best CREZ” portfolio*
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** Prior to adding renewables, south-to-north flows on Path 15 were increased from July summer peak case (to 5168 MW)
- **Results:** Overloads in/on
 - Barren Ridge-Haskell Canyon area
 - five 230 kV lines along Path 15
 - 230 kV Barre-Ellis line in Los Angeles basin
 - Sycamore Canyon 230/138 kV xfmr in the San Diego area

* Includes 5000 MW of installed capacity in the Westlands CREZ which is connected to Gates substation.

Scenario: RETI-BC_Bns

- **Objective:** Study high north-to-south flows on Path 26
- **Load:** So. CA 1-in-10 July peak load
- **Renewable Additions:** RETI “Best CREZ” portfolio*
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** Prior to adding renewables, north-to-south flows on Path 26 were increased from July summer peak case (to 3550 MW)
- **Results:** Overloads in/on
 - Barren Ridge-Haskell Canyon area
 - Lines south of Kramer substation
 - Two 230 kV lines along Path 15
 - Eight 230 kV lines in the Los Angeles basin
 - Sycamore Canyon 230/138 kV xfmr in the San Diego area

* Includes 5000 MW of installed capacity in the Westlands CREZ which is connected to Gates substation.

Scenario: A-Q_CO2

- **Objective:** Minimize carbon footprint
- **Load:** No. CA 1-in-10 July peak load
- **Renewable Additions:** CTPG queue portfolio
- **Fossil-Fired Decrements:** 98% out-of-state coal
- **Power flows:** East of River flows are west to east at low levels
- **Results:** Overloads on/in
 - Bannister-El Centro
 - Barren Ridge-Haskell Canyon
 - Path 15
 - Mirage-Eagle Mountain system
 - Lugo-Kramer
 - San Diego area

Scenario: B-Q_CO2

- **Objective:** Minimize carbon footprint
- **Load:** So. CA 1-in-10 July peak load
- **Renewable Additions:** CTPG queue portfolio
- **Fossil-Fired Decrements:** 98% out-of-state coal
- **Power flows:** East of River flows are west to east at low levels
- **Results:** Overloads on
 - Bannister-El Centro
 - Barren Ridge-Haskell Canyon
 - Path 15
 - Mirage-Eagle Mountain system
 - Lugo-Kramer
 - San Diego area

Scenario: A-Northern

- **Objective:** Re-study high north-to-south flows on COI, DC Pacific Intertie and Path 26
- **Load:** No. CA 1-in-10 July peak load
- **Renewable Additions:** So. CA renewables in CTPG queue portfolio adjusted to reflect 40% of energy coming from:
 - No. CA
 - northwestern NV
 - Pacific Northwest
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** Prior to adding renewables, north-to-south flows on
 - COI were set at 4800 MW,
 - DC Pacific Intertie were set at 3100 MW
 - Path 26 increased from July summer peak case (to 3712 MW)
- **Results:** Overloads in/on
 - Pacific AC intertie
 - Tracy 500/230 kV xfmrs
 - One 230 kV line in Sacramento area
 - 500 kV Midway-Whirlwind line

Scenario: Autumn

- **Objective:** Study a high south-to-north flows on Path 15 during light load conditions
- **Load:** Typical load at 8:00 am in September
- **Renewable Additions:** CTPG queue portfolio
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** Prior to adding renewables, south-to-north flows on Path 15 were increased from July summer peak case (to 5032 MW)
- **Results:**
 - Major overloads on Path 15
 - Overload of the Eldorado-Pisgah series capacitor

Alternative: 500 kV Talega-Escondido/Valley-Serrano (TE/VS)

- **Objective:** Determine if TE/VS addresses needs in Los Angeles basin and/or San Diego areas
- **Load:** So. CA 1-in-10 July peak load
- **Renewable Additions:** CTPG queue portfolio
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** When TE/VS phase shifters are set to 1000 MW
 - flows along coast swing in the opposite direction by 700 MW
 - changes flows in Orange County and on the eastern side of San Diego area system.
- **Results:** Mitigates several Los Angeles basin overloads, but creates new overloads in the both the Los Angeles basin and San Diego areas depending on the phase shifter settings.

Note: *The Nevada Hydro Company does not agree with the study assumptions or results.*

Alternative: 500 kV Double Circuit North Gila-Highline-Imperial Valley

- **Objective:** Determine if new 500 kV NG-HL-IV and NG-IV lines will address needs in the Imperial Valley area
- **Load:** So. CA 1-in-10 July peak load
- **Renewable Additions:** CTPG Southwest portfolio
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:**
 - B-Q scenario has the highest flows on the existing 500 kV NG-IV line.
 - Adding the 500 kV NG-HL-IV and NG-IV lines increases flows into the San Diego area and decreases flows on the West of Devers system.
- **Results:**
 - Exacerbates previously-identified overloads in the San Diego area.
 - May represent an alternative to 230 kV upgrades in the southern portion of the IID system, although the study raises the question if some of those upgrades (e.g., the 230 kV El Centro-Highline upgrade) actually contribute to reaching a power flow solution to begin with.

Alternative: Path 52 Upgrade for Nevada Resources

- **Objective:** Determine whether an upgrade to Path 52 would address needs in the Owens Valley area
- **Load:** Load levels are not a determinative factor.
- **Renewable Additions:**
 - All CTPG renewable development portfolios were considered.
 - Terra-Gen Power's suggestion to assume 1000 MW in northern NV was not considered.
- **Fossil-Fired Decrements:** Fossil generation decrements not a determinative factor.
- **Power flows:**
 - CTPG modeled northern NV resources as delivered via the proposed Ravendale-Zeta1 500 kV system.
 - CTPG modeled central NV resources as delivered via the existing Dixie Valley-Control line as far south as a new Aurora substation, with a new 230 kV line parallel to the existing Dixie Valley-Control line from Aurora south to a new NewSub substation near Control, and then south to Inyokern substation.
- **Results:**
 - Because Path 52 is radial to the weak 115 kV system south of Control, an upgrade of Path 52 will not contribute to reaching a power flow solution and will not mitigate any identified reliability criteria violations south of Control.
 - Path 52 could be an alternative to the new 230 kV line between Aurora and NewSub, but only if renewable resource development in NV takes place along the Silver Peak-Control line rather than the Dixie Valley-Control corridor.

Alternative: 230 kV Los Banos-Westley #2 line

- **Objective:** Determine if a second Los Banos-Westley circuit will mitigate contingency-based overloads of the existing Los Banos-Westley circuit that occur with high south-to-north flows on Path 15
- **Load:** No. CA 1-in-10 July peak load
- **Renewable Additions:** CTPG queue portfolio
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** Prior to adding renewables in Asn-Q scenario, south-to-north flows on Path 15 were increased from July summer peak case (to 5168 MW)
- **Results:**
 - Does not eliminate central CA 230 kV overloads identified in Phase 2 studies
 - One Los Banos-Westley line overloads for the outage of the other
 - Splitting existing Los Banos-Westley line into two lines and reconductoring both lines significantly improves performance and may be a better alternative.

Alternative: +/- 500 kV DC Tracy NV- Table Mountain Line (“Great Basin”)

- **Objective:** Determine whether a +/- 500 kV DC line between Tracy NV and Table Mountain substation would mitigate reliability criteria violations in northern CA identified in CTPG’s Phase 2 studies.
- **Load:** Performance under different load levels was not assessed.
- **Renewable Additions:** Performance with different renewable portfolios was not assessed.
- **Fossil-Fired Decrements:** Performance with different fossil generation decrements was not assessed.
- **Power flows:**
 - CTPG Technical Steering Committee believes injections of power from the DC line at Table Mountain will reduce the maximum amount of power that is currently allowed to be imported on COI.
 - 1 MW injected at Table Mountain reduces allowable COI imports by 0.25 MW.
 - 1000 MW injected at Table Mountain reduces allowable COI imports by 1000 MW.
- **Results:**
 - Table Mountain substation will need to be upgraded
 - To avoid a reduction in the maximum amount of power that is currently allowed to be imported on COI, major transmission upgrades in addition to the proposed alternative would be required

Note: *Great Basin Energy Development has requested that CTPG study different injection locations for the CA terminus of the line.*

Alternative: 500 kV Malin-Raven-Valley Road (NV)-Rancho Seco Line (“Sierra Green Link”)

- **Objective:** Determine if a 500 kV line between Malin, the Reno NV area, and the Sacramento area would address needs in northern CA with high north-to-south flows
- **Load:** No. CA 1-in-10 July peak load
- **Renewable Additions:** So. CA renewables in CTPG queue portfolio adjusted to reflect 40% of energy coming from:
 - No. CA
 - northwestern NV
 - Pacific Northwest
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** Prior to adding renewables, north-to-south flows on
 - COI were set at 4800 MW,
 - DC Pacific Intertie were set at 3100 MW
 - Path 26 increased from July summer peak case (to 3712 MW)
- **Results:**
 - Alternative is assumed to replace
 - 500 kV Raven-Zeta1 line, 500 kV Zeta1-Olinda line, 500 kV Zeta1-Round Mountain #1 line
 - 500 kV Captain Jack-Olinda #2 line
 - 500 kV Olinda-Tracy #2 line
 - Eliminates one N-2 overload in Sacramento area and two N-2 overloads between Tesla and Tracy
 - Creates overloads on
 - 500 kV Round Mountain-Table Mountain #1 & #2 lines
 - 500/230 kV Table Mountain xfmr
 - Three 230 kV lines in northern CA

Alternative: 230 kV Tesla-Newark #3 Line

- **Objective:** Determine if a third 230 kV line between Tesla and Newark would address needs in the San Francisco Bay area with high south-to-north flows on Path 15
- **Load:** No. CA 1-in-10 July peak load
- **Renewable Additions:** CTPG queue portfolio
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** Prior to adding renewables in Asn-Q scenario, south-to-north flows on Path 15 were increased from July summer peak case (to 5168 MW)
- **Results:** Alternative does not eliminate identified reliability criteria violations

Alternative: +/- 500 kV DC Devers-Mira Loma Line (“Metro Renewable Express”)

- **Objective:** Determine if a +/- 500 kV DC Devers-Mira Loma line will address needs on the West of Devers system
- **Load:** So. CA 1-in-10 July peak load
- **Renewable Additions:** CTPG queue portfolio
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:**
 - The inverters were set to deliver 2000 MW from Devers to Mira Loma.
 - This reduces the loading on the West of Devers lines.
- **Results:** Mitigates the West of Devers overloads.

Alternative: +/- 500 kV DC Marketplace-Rancho Vista Line

- **Objective:** Determine if a +/- 500 kV double circuit line between Marketplace and Rancho Vista (Los Angeles basin) will mitigate reliability criteria violations along the So. NV-East of Lugo corridor.
- **Load:** Load levels do not appear to be a determinative factor.
- **Renewable Additions:** All CTPG renewable resource portfolios are relevant.
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** All scenarios are applicable.
- **Results:**
 - There are no reliability criteria violations along the So. NV-East of Lugo corridor in the summer peak cases.
 - However, the Autumn case identified an overload of the series capacitor on the existing 500 kV El Dorado-Pisgah line. The proposed alternative would mitigate the overload of the series capacitor.

Alternative: DC Pacific Intertie Upgrade

- **Objective:** Determine if upgrading the Celilo and Sylmar AC/DC converter stations would address needs in northern CA with high north-to-south flows
- **Load:** No. CA 1-in-10 July peak load
- **Renewable Additions:** So. CA renewables in CTPG queue portfolio adjusted to reflect 40% of energy coming from:
 - No. CA
 - northwestern NV
 - Pacific Northwest
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** Prior to adding renewables, north-to-south flows on
 - COI were set at 4800 MW
 - DC Pacific Intertie were set at 3400 MW
 - Path 26 increased from July summer peak case (to 3712 MW)
- **Results:**
 - Alternative is assumed to replace
 - 500 kV Captain Jack-Olinda #2 line
 - 500 kV Olinda-Tracy #2 line
 - With DC Pacific Intertie at 3410 MW south-to-north, flows on COI reduced by 240 MW
 - 240 MW reduction in COI imports not enough to avoid N-2 overloads in Tracy/Tesla area

Alternative: +/- 500 kV DC El Dorado-Devers (“Pony Express Project”)

- **Objective:** Determine if a +/- 500 kV DC line between El Dorado and Devers will mitigate reliability criteria violations along the So. NV-East of Lugo corridor.
- **Load:** Load levels do not appear to be a determinative factor.
- **Renewable Additions:** All CTPG renewable portfolios are relevant.
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** All scenarios are applicable.
- **Results:**
 - There are no reliability criteria violations along the So. NV-East of Lugo corridor in the summer peak cases.
 - However, the Autumn case identified an overload of the series capacitor on the existing 500 kV El Dorado-Pisgah line. The proposed alternative would mitigate the overload of the series capacitor.

Alternative: 500 kV Eagle Mountain-Red Bluff-Devers #1 & #2 Lines (“Green Energy Express”)

- **Objective:** Determine if a 500 kV double circuit line between Red Bluff and Devers will mitigate reliability criteria violations on the existing Eagle Mountain-Mirage system.*
- **Load:** So. CA 1-in-10 July peak load
- **Renewable Additions:**
 - CTPG queue portfolio
 - No generation or load was modeled as connecting to the new 500 kV Eagle Mountain substation.
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** The Green Energy Express project has a limited effect on power flows on the existing Eagle Mountain-Mirage system.
- **Results:** Mitigates only one of the reliability criteria violations on the existing Eagle Mountain-Mirage system.

* The Green Energy Express project also includes a double circuit 500 kV line between the planned Red Bluff substation and a new 500 kV Eagle Mountain substation. Because the project proponent does not propose to connect its new substation at Eagle Mountain to MWD's system, this portion of the Green Energy Express project is radial to the existing network and has no affect on Mirage-Eagle Mountain system.

Alternative: Convert existing 500 kV Mead-Adelanto and Mead-Phoenix lines to Direct Current (“Mead Green Upgrade”)

- **Objective:** Determine if converting existing 500 kV AC lines to direct current lines will mitigate reliability criteria violations along the So. NV-East of Lugo corridor.
- **Load:** Load levels do not appear to be a determinative factor.
- **Renewable Additions:** All CTPG renewable resource development scenarios are relevant.
- **Fossil-Fired Decrements:** 70%/30% in/out-of-state gas
- **Power flows:** All scenarios are applicable.
- **Results:**
 - There are no reliability criteria violations along the So. NV-East of Lugo corridor in the summer peak cases.
 - However, the Autumn case identified an overload of the series capacitor on the existing 500 kV El Dorado-Pisgah line. The proposed alternative would mitigate the overload of the series capacitor.