Brightline West High-Speed Rail Load Interconnection Request

SCE Integrated System Analysis
Transmission & Distribution
November 17, 2020
Brightline West plans to build and operate a new high-speed electric passenger train with service from Southern California to Las Vegas, NV

- Train speeds up to 200 mph
- Target to reduce the environmental impact of ~50M annual one-way trips between these areas
- Authorized for up to $4.2B in private activity bond allocations from CA, NV, and US DOT
- Expecting to start commercial operation in early 2024

Phase 1 – Victorville, CA to Las Vegas, NV

- Nominal track length of 170 miles
- Customer submitted a request to SCE for two delivery points of service

Brightline West has announced plans to expand to Rancho Cucamonga, CA and necessary service will be analyzed in subsequent load studies.

Source: Brightline - West Coast
https://www.gobrightline.com/west-coast-expansion
Load Studies To-Date

Brightline West Technical Requirements:
• SCE to provide two connections for retail electric service at each of the two delivery point locations:
  • Ivanpah Delivery Point: 56 MW total load
  • Barstow Delivery Point: 56 MW total load
• Customer to own, operate, and maintain power electronics-based converters to connect SCE system to their medium voltage overhead catenary system
• Dynamic load profile results in regeneration of power onto the SCE subtransmission system at the delivery points
  • Method of service (load study) submitted to Customer in May 2020
  • Generator interconnection study in-progress
• Customer requested in-service date in early 2023 to begin commercial operation in early 2024

Study Scope:
• Preliminary scope and cost estimation for interconnection and network upgrades
  • Interconnection Facility
  • Network Upgrade for Interconnection
• Mitigation plans to tackle adverse system impacts
• Customer and SCE signed Letter Agreement in May 2020 for engineering and design
Proposed Customer Electric Delivery Points

Point of Service No. 1
Expand existing Ivanpah 115 kV Switchrack

Point of Service No. 2
Loop-in of Kramer-Tortilla 115 kV Subtransmission Line

Source: California Energy Commission (CEC) Map of Southern California Electric Generation and Transmission Infrastructure. Data is from the California Energy Infrastructure Database (CEIDB)
Point of Service 1 – Ivanpah Delivery Point (IDP)

Project Scope – Interconnection (In-Service Date Q1 2023)

• Construct a new 115 kV four breaker ring bus substation
• Equip two new double-bus double-breaker (DBDB) positions at the existing SCE Ivanpah 115 kV Substation
• Construct two diversely routed 3 mile 115 kV subtransmission lines from Ivanpah Substation to the new ring bus substation

System Impact Study:

• No thermal or voltage issues identified
• Requires modifications to existing remedial action schemes

Cost Estimate (in $Million):

• Interconnection Facilities: $20
• Network Upgrades (Interconnection): $4*
• Network Upgrades (Mitigation): $0

* The only CAISO-controlled portions of this delivery point scope are the Ivanpah 115 kV bus extension and circuit breakers
Point of Service 2 – Barstow Delivery Point (BDP)

Project Scope – Interconnection (In-Service Date Q1 2023)
- Construct a breaker-and-a-half (BAAH) 115 kV switching station with seven circuit breakers
- Loop in the existing Kramer-Tortilla 115 kV Subtransmission Line

System Impact Study:
- No thermal issues identified
- Violation of applicable reliability standards and planning criteria:
  - Post Contingency Steady State Voltage Deviation
    - N-1 of Kramer-BDP 115 kV
    - N-1 of Kramer-Cool Water 115 kV
  - Post Contingency Steady State Voltage
    - N-1 of Kramer-BDP 115 kV
    - N-1 of Kramer-Cool Water 115 kV

Cost Estimate (in $Million):
- Interconnection Facilities: $2
- Network Upgrades (Interconnection): $10*
- Network Upgrades (Mitigation): $47

* The entire proposed BAAH loop-in substation at Barstow will be CAISO-controlled, which results in a higher portion of this cost as a network upgrade
Point of Service 2 – BDP Mitigation (1/2)

Project Construction Scope – Mitigation
(In-Service Date Q2 2024)

- Construct a 220/115 kV transformer bank to connect the existing Cool Water 220 kV and Cool Water 115 kV Switchracks
  - Install one (1) DBDB 220 kV Position, one (1) DBDB 115 kV Position and one (1) new 220/115 kV transformer
  - Install tie line from existing 220 kV to substation expansion and a new 115 kV tie line to the substation expansion

Reliability and Area Assessment

- Reinforces Kramer 115 kV area to avoid N-1 voltage violations
- Reclassifies existing 220 kV radial facilities to network ISO control
  - Sandlot 220 kV Substation
  - Kramer – Cool Water 220 kV line
  - Kramer – Sandlot and Cool Water – Sandlot 220 kV lines
  - Reclassification would add a depreciated portion of the facilities above to FERC rate base
- Other system benefits:
  - Improves reliability and operational flexibility in the Kramer Subtransmission System
  - Strengthens the system under N-0 and N-1 conditions
  - Expands CAISO network footprint to accommodate additional future load, generation and energy storage projects
# Point of Service 2 – BDP Mitigation (2/2)

## Preferred Mitigation

<table>
<thead>
<tr>
<th>Preferred Mitigation</th>
<th>Considerations</th>
</tr>
</thead>
</table>
| Construct a 220/115 kV transformer bank to connect the existing Cool Water 220 kV and Cool Water 115 kV Switchracks | • Improves system reliability and operational flexibility  
  • Low technical risk and environmental impact due to use of standard substation equipment and existing SCE land  
  • Beneficial in addressing existing and future reliability concerns independent of the train |

## Alternative Mitigations

<table>
<thead>
<tr>
<th>Alternative Mitigations</th>
<th>Considerations</th>
</tr>
</thead>
</table>
| 1. Loop-in existing Kramer-Cool Water 220 kV transmission line                        | • Increases substation loop-in costs  
  • Timing conflicts with the customer requested in-service date  
  • Highest environmental impact                                                                 |
| 2. New Kramer-BDP No.2 115 kV subtransmission line                                    | • Provides a reduced benefit to the Kramer 115 kV system as compared to the 220/115 kV transformer bank  
  • Timing conflicts with the customer requested in-service date  
  • Highest environmental impact                                                                 |
| 3. Dynamic voltage support device                                                     | • Does not provide the benefit of an additional source to the Kramer 115 kV system  
  • Anticipate higher lifetime O&M and capital replacement costs due to active control systems  
  • Highest technical risk and less scalable for future needs                              |
## Summary

<table>
<thead>
<tr>
<th>Location</th>
<th>Interconnection Facilities – Cost ($M)</th>
<th>Network Upgrades (Interconnection) - Scope &amp; Cost ($M)</th>
<th>Network Upgrades (Mitigation) – Cost ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery Point 1: Ivanpah</td>
<td>$20</td>
<td>• Extend 115 kV bus at Ivanpah Substation</td>
<td>$4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Equip two (2) 115kV Positions with 2 circuit breakers</td>
<td>$0</td>
</tr>
<tr>
<td>Delivery Point 2: Barstow</td>
<td>$2</td>
<td>• One (1) new BAAH 115kV Substation</td>
<td>$10</td>
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<td></td>
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<td>• Subtransmission to loop existing line into the new substation</td>
<td>$47</td>
</tr>
<tr>
<td>Total ($M)</td>
<td>$22</td>
<td>$14</td>
<td>$47</td>
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### Assumptions

- Scope and costs provided are conceptual and derived from the 2020 SCE CAISO Unit Cost Guide.
- Estimates do not provide allocation of standard and added facilities. Customer will be responsible for appropriate facilities charges in accordance with SCE Rule 2 and other applicable tariffs.
- Mitigation costs include an estimated depreciated portion of the interconnection facilities at Sandlot 220 kV Substation and radial Kramer – Cool Water, Cool Water – Sandlot, and Sandlot – Kramer 220 kV lines.
- Multiple maintenance, reliability and generator interconnection projects currently exist in the Cool Water area and as such, opportunities to optimize design and bundle for construction and capital efficiency may exist.