Via email

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Economic Planning Study Request
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California Independent System Operator
250 Outcropping Way, Folsom, CA 95630

**Economic Study Request - Boardman to Hemingway (B2H) 500 kV Transmission Project**

To whom it may concern:

Idaho Power appreciates the opportunity to submit an economic planning study into the 2019-2020 CAISO Transmission Planning Process.

The permitting partners of the Boardman to Hemingway 500 kV transmission project (B2H), Bonneville Power Administration, PacifiCorp, and Idaho Power, have completed extensive study work on the B2H project, and believe the project has potential to provide substantial benefits to the western interconnection. A few of the benefits of interest to CAISO are:

1) Increased COI capacity due to the B2H parallel path,
2) Reduced CAISO reactive burden, specifically reduced need for a Round Mountain SVC,
3) Decrease greenhouse gas emissions, and
4) Additional geographically diverse capacity path between the Pacific Northwest, PacifiCorp, Idaho Power and California.

Thus, the permitting partners are submitting this economic planning study request with additional supporting details in the attached overview. Idaho Power, and the B2H permitting partners, look forward to working with the CAISO to further explore these and any other potential benefits.

Best Regards,

David M. Angell
Senior Manager, Transmission & Distribution Planning

# Boardman to Hemingway 500 kV Transmission Project Overview

## Project Overview

Bonneville Power Administration (BPA), PacifiCorp, and Idaho Power jointly proposed to design, construct, operate and maintain a new 500 kV, single-circuit electric transmission line from a proposed substation near Boardman, Oregon to the Hemingway substation near Melba, Idaho – known as the Boardman to Hemingway Transmission Line Project or B2H Project. Idaho Power is leading the permitting process for the Project.

## Project Permitting Status

The U.S. Bureau of Land Management (BLM) released its Record of Decision (ROD) for the Boardman to Hemingway Transmission Line Project (B2H) on Nov. 17, 2016. The ROD allows BLM to grant right-of-way to Idaho Power for the construction, operation, and maintenance of the B2H Project on BLM-administered land. The approved route is the Agency Preferred Alternative identified in the *Final Environmental Impact Statement (EIS) and Proposed Land-use Plan Amendments*.

For all lands crossed in Oregon, Idaho Power must receive a site certificate from the Energy Facility Siting Council (EFSC) prior to constructing and operating the proposed transmission line. The Oregon Department of Energy (ODOE) is staff to EFSC and facilitates the review of the site certificate application process. ODOE and EFSC will review Idaho Power's application for compliance with state energy facility siting standards.

The U.S. Forest Service (USFS) issued a separate ROD on Nov. 9, 2018 for lands administered by the USFS based on the analysis in the Final EIS. The USFS ROD approves the issuance of a special-use authorization for a portion of the project that crosses the Wallowa-Whitman National Forest. Read more about the National Environmental Policy Act (NEPA) process on the federal process page.

## Project In-Service Date

Summer 2026

## Estimated Project Cost

$1.0 – $1.2 billion

## Project website:

www.boardmantohemingway.com

# Economic Consideration #1 – Increased COI Capacity

## Background

The COI, a heavily utilized transmission path between the Pacific Northwest (PNW) and CAISO, currently has a north-to-south rating of 4800 MW. This rating can be limited by constraints on the PNW side of the COI and the CAISO side of the COI. The B2H project alleviates the constraints on both sides of the COI, and potentially allows for an increased COI rating, and increased COI utilization during normal and outage conditions.

## Potential CAISO – B2H Improvements

The B2H 500 kV line will include approximately 50% series compensation. For modeling associated with this economic planning study submittal, the B2H project includes expanding this series compensation to 75%; the added compensation would generally be bypassed, like the Fort Rock series capacitors, and available via RAS/SPS to support post-transient system performance for critical contingencies. The Idaho to Northwest path is currently limited in its ability to absorb significant impacts from adjacent transmission systems, however with the 500 kV B2H line, this ability is greatly enhanced.

## PNW COI Constraints Relieved by B2H

The B2H project, when combined with the Hemingway-Summer Lake 500 kV line, effectively parallels the PNW 500 kV system between John Day, Grizzly and Summer Lake. To get a comparison between the existing system, and a system with B2H, two cases were developed.

**Case Existing System**: COI is stressed to 4800 MW and the Idaho to Northwest path is stressed to its Accepted Rating, 1200 MW west-to-east. Hemingway-Summer Lake (Path 75) is simultaneous stressed to its Accepted Rating of 550 MW west-to-east.

**Case +B2H**: COI is stressed to 4800 MW and the Idaho to Northwest path is stressed to its post-B2H Accepted Rating, 2250 MW west-to-east. Path 75 is unstressed due to the parallel B2H line.

Case +B2H & Series Cap Insertion: This is the same as the +B2H case, however an additional series capacitor is added to the B2H 500 kV line and switched post-contingency to mitigate overloads associated with critical contingencies.

The following are a listing of the critical PNW contingencies, and how B2H will assist in addressing them, and relieve the northern COI constraint.

### Critical Contingency. N-2: John Day – Grizzly #2 & Buckley – Grizzly #1 500 kV lines (thermal)

In this case, the critical contingency results in overloading the John Day – Grizzly #1 500 kV line.

| | Existing System | +B2H | +Series Cap Insertion |
|---|---|---|---|
| Critical Overload % | 115.0% | 102.9% | 95.1% |

The system with B2H shows superior results for this COI critical contingency. Adding an additional series capacitor segment to the B2H line, to be switched post-contingency, further increases performance.

### Critical Contingency. N-2: Grizzly – Malin & Grizzly – Summer Lake 500 kV lines (thermal)

In this case, the critical contingency results in overloading the Grizzly – Capt. Jack 500 kV line.

| | Existing System | +B2H | +Series Cap Insertion |
|---|---|---|---|
| Critical Overload % | 111.8% | 97.9% | 89.6% |

The system with B2H shows superior results for this COI critical contingency.

### Critical Contingency. 2PV (voltage stability)

The table below details post-contingency voltage deviations for this critical contingency.

| | Existing System | +B2H | +Series Cap Insertion |
|---|---|---|---|
| Grizzly | -0.30% | -0.58% | +0.88% |
| Malin | -2.49% | -2.66% | -1.22% |
| Round Mountain | -2.46% | -2.57% | -1.52% |
| Table Mountain | -2.40% | -2.49% | -1.65% |

The PNW system shows superior voltage deviation results at Grizzly, Malin, and other busses in the PNW. This is a direct indication that the B2H project enhances voltage stability in the region, and will provide value during normal and emergency conditions.

The CAISO Round Mountain and Table Mountain bus voltage deviation results will be discussed more in Economic Consideration #2.

### Critical Contingency. PDCI Bi-Pole (voltage stability)

The table below details post-contingency voltage deviations for this critical contingency.

| | Existing System | +B2H | +Series Cap Insertion |
|---|---|---|---|
| Grizzly | -0.55% | -0.78% | +0.82% |
| Malin | -3.14% | -3.24% | -1.63% |
| Round Mountain | -3.25% | -3.30% | -2.10% |
| Table Mountain | -3.05% | -3.08% | -2.11% |
| Gates | -1.93% | -1.93% | -1.71% |

These results mirror the 2PV contingency showing superior post-transient voltage performance for critical busses along the COI.

## CAISO COI Constraints Relieved by B2H

In 2018, CAISO performed extensive study work showing that the COI could potentially be increased to 5,100 MW by considering certain N-2 contingencies conditionally credible, and/or installing a CAISO load shedding scheme to deal with the critical N-2 contingencies. B2H, and a B2H series capacitor insertion scheme, would address many of the issues north of the California-Oregon border, and could also be utilized to reduce the impact of major outages south of the California-Oregon border.

### Critical Contingency. N-1: Round Mountain – Table Mountain #1

The N-1 loss of Round Mountain – Table Mountain #1 or #2 defines the COI versus North California Hydro nomogram. The impact of B2H and the B2H series capacitor insertion scheme on the system for loss of Round Mountain – Table Mountain #1, are below:

| | Existing System | +B2H | +Series Cap Insertion |
|---|---|---|---|
| Round Mtn – Table Mtn #1 (Pre Contingency) | 56.8% | 56.6% | 56.6% |
| Round Mtn – Table Mtn #2 (Pre Contingency) | 57.3% | 57.0% | 57.0% |
| Round Mtn – Table Mtn #2 (Post Contingency) | 102.9% | 102.4% | 100.2% |

*Percentages are percent of Limit B Amps*

Following the loss of Round Mountain – Table Mountain #1, the B2H line and B2H series capacitor insertion scheme can shift 2.7% of the flow off the remaining Round Mountain – Table Mountain #2 line. CAISO could utilize this for higher pre-contingency path flows during both system normal and during outage conditions, or to reduce the COI v NCH nomogram.

### Critical Contingency. N-2: Malin - Round Mountain #1 & #2

The N-2 loss of Malin – Round Mountain #1 & #2 is one of the critical contingencies that limits the COI south of the California-Oregon border. The impact of B2H and the B2H series capacitor insertion scheme on the system following this critical contingency are below:

| | Existing System | +B2H | +Series Cap Insertion |
|---|---|---|---|
| Captain Jack – Olinda (Olinda Series Cap) | 93.6% | 92.5% | 90.6% |

*Percentages are percent of Limit B Amps*

Following the loss of Malin – Round Mountain #1 & #2, the B2H line and B2H series capacitor insertion scheme can shift 3% of the flow off the remaining Captain Jack – Olinda line. CAISO could leverage this post-contingency reduction to facilitate higher pre-contingency path flows.

## Conclusion

B2H significantly enhances the performance of critical contingencies north of the California/Oregon border, and provides substantial reactive support to the COI path. B2H, in combination with the changes identified in the 2018 “Pacific Northwest – California Transfer Increase Informational Special Study,” would allow COI to be increased to 5,100+ MW. B2H also provides a reinforced parallel path to the COI which will reduce derates caused by outages, and add resiliency to the AC intertie.

# Economic Consideration #2 – Reduced CAISO Dynamic Reactive Needs

## Background

In the CAISO Draft 2018-2019 Transmission Plan, CAISO specifies the need for 500 MVAr in dynamic reactive support at the Round Mountain substation and the need for 800 MVAr in dynamic reactive support at the Gates substation.

At Round Mountain, one of the key reasons for a 500 MVAr dynamic reactive device was system performance following a PDCI Bi-Pole outage. CAISO is forced to operate the system at a higher voltage than is desired to withstand the impact of the major PDCI contingency. The B2H project, as a parallel path to the COI, will help offload the burden of this contingency, and may be able to serve a portion of this dynamic reactive need, allowing for reduced size dynamic reactive devices.

### Critical Contingency. PDCI Bi-Pole (voltage stability)

As detailed in Economic Consideration #1, the addition of B2H, and a series capacitor insertion scheme, can significantly reduce the voltage swings on the CAISO system post-contingency. Copied from Economic Consideration #1, the table below details post-contingency voltage deviations for the critical PDCI Bi-Pole contingency.

| | Existing System | +B2H | +Series Cap Insertion |
|---|---|---|---|
| Grizzly | -0.55% | -0.78% | +0.82% |
| Malin | -3.14% | -3.24% | -1.63% |
| Round Mountain | -3.25% | -3.30% | -2.10% |
| Table Mountain | -3.05% | -3.08% | -2.11% |
| Gates | -1.93% | -1.93% | -1.71% |

In this outage configuration, each 1% voltage deviation at Round Mountain is approximately 200 MVAr.

The Round Mountain 500 kV bus, given today's transmission system, deviates by 3.25% following the full loss of the PDCI. The voltage deviation is significantly reduced following the installation of B2H, and the availability of a series capacitor that could be inserted post PDCI contingency. Based on these results, if the PDCI Bi-Pole outage is one of the limiting contingencies driving the need for 500 MVAr of dynamic reactive support as detailed in the CAISO Draft 2018-2019 Transmission Plan, this dynamic reactive support need could be reduced by as much as 200 MVAr following the installation of B2H.

The Gates 500 kV bus appears to be much less impacted by the addition of B2H. Additionally, the CAISO Draft 2018-2019 Transmission Plan does not reference the loss of PDCI as a driver for dynamic reactive support at Gates substation, however the information is included in the table above for informational purposes.

# Economic Consideration #3 – Capacity Path to the PNW

## Background

B2H alone could potentially facilitate increased COI transfers, but cannot provide an independent geographically diverse contract path between the PNW and CAISO. The combination of B2H, Midpoint – Cedar Hill (a permitted segment of Gateway West), and SWIP North, all federally permitted projects, would collectively provide CAISO with an additional geographically diverse capacity path between the PNW and California and a new capacity path between PacifiCorp, Idaho Power and California.

A transmission connection to the PNW, PacifiCorp, and Idaho Power would provide CAISO with (1) a resource capacity connection to help CAISO meet late summer peak needs, summer peak needs that are diverse from the peaking needs of Idaho Power, PacifiCorp, and the PNW, and (2) a geographically diverse transmission connection to the PNW, providing resiliency to the AC intertie.

## Transmission as a Resource

The PNW continues to predominately remain a winter-peaking region. Based on independent forecasts by the Northwest Power and Conservation Council, BPA, and others, the region will continue to remain winter peaking for the foreseeable future. These studies do not generally consider the additional availability of Canadian hydro. As California utilities have shown, a transmission connection to the PNW can be an extremely valuable, and cost-effective resource to meet customers electrical demands.

The total cost of a connection between the PNW, PacifiCorp, Idaho Power and CAISO is below.

| Segment | Length (miles) | Cost ($Millions) |
|---|---|---|
| Longhorn-Hemingway (B2H) | 290 | $1,000 - $1,200 |
| Hemingway – Cedar Hill (Midpoint area) | 161 | $530* |
| Midpoint – Robinson Summit | 275 | $550** |
| **TOTAL** | **736** | **$2,080 – $2,280** |

*TEPPC Calculator

**SWIP North public information

The total capacity cost of this transmission resource / connection is $832-$912 per kW, assuming the path is fully subscribed bidirectionally at 1,250 MW. As a capacity resource, this is substantially less than the capacity cost of any thermal plant, the transmission line is carbon neutral, and the path links PNW hydro/ramping/storage resources with the best solar region (southern California/Arizona) in the continental United States.

## SWIP North Enhancement to Economic Consideration #1

The addition of the SWIP North project, in combination with B2H, enhances the performance discussed in Economic Consideration #1 – especially performance related to contingencies south of the COI interface.

Depending on CAISO's needs, the Midpoint – Cedar Hill line may not be required and is not modeled or further considered in enhancing Economic Consideration #1. Additionally, like the series capacitor added and normally bypassed in the B2H line – available for post-contingency switching – a series capacitor has been added to SWIP North line for similar purposes. For modeling associated with this economic planning study submittal, the SWIP North project includes expanding this series compensation to 75%;

the added compensation would generally be bypassed, like the Fort Rock series capacitors, and available via RAS/SPS to support post-transient system performance for critical contingencies.

### CAISO Constraints Relieved by B2H+SWIP

The N-1 loss of Round Mountain – Table Mountain #1 or #2 defines the COI versus North California Hydro nomogram. The impact of B2H, SWIP North, and series capacitor insertion schemes on the system for loss of Round Mountain – Table Mountain #1, are below:

N-1 Round Mtn – Table Mtn #1 contingency – COI at 4800 MW in all cases

| | Existing System | +B2H | +Series Cap Insertion | +B2H+SWIP | +B2H+SWIP +Series Cap Insertions |
|---|---|---|---|---|---|
| Round Mtn – Table Mtn #1 (Pre Contingency) | 56.8% | 56.6% | 56.6% | 56.6% | 56.6% |
| Round Mtn – Table Mtn #2 (Pre Contingency) | 57.3% | 57.0% | 57.0% | 57.0% | 57.0% |
| Round Mtn – Table Mtn #2 (Post Contingency) | 102.9% | 102.4% | 100.2% | 102.0% | 98.2% |

*Percentages are percent of Limit B Amps*

Following the loss of Round Mountain – Table Mountain #1, B2H and SWIP North can shift 4.7% of the flow off the remaining Round Mountain – Table Mountain #2 line. CAISO could utilize this for higher pre-contingency path flows, or to reduce the COI v NCH nomogram.

The N-2 loss of Malin – Round Mountain #1 & #2 is one of the critical contingencies that limits the COI south of the California-Oregon border. The impact of B2H, SWIP North and series capacitor insertion schemes on the system following this critical contingency are below:

N-2 Malin - Round Mtn #1 & #2 contingency – COI at 4800 MW in all cases

| | Existing System | +B2H | +Series Cap Insertion | +B2H+SWIP | +B2H+SWIP+Series Cap Insertions |
|---|---|---|---|---|---|
| Captain Jack – Olinda (Olinda Series Cap) | 93.6% | 92.5% | 90.6% | 91.7% | 87.4% |

*Percentages are percent of Limit B Amps*

Following the loss of Malin – Round Mountain #1 & #2, the B2H line and SWIP North can shift 6.2% of the flow off the remaining Captain Jack – Olinda line. CAISO could leverage this post-contingency reduction to facilitate higher pre-contingency path flows.

## SWIP North Enhancement to Economic Consideration #2

The addition of the SWIP North project, in combination with B2H, enhances the performance discussed in Economic Consideration #2 – further reducing the voltage deviation burden of critical contingencies that affect the COI.

### Critical Contingency. PDCI Bi-Pole (voltage stability)

The table below details post-contingency voltage deviations for this critical contingency.

| | Existing System | +B2H | +Series Cap Insertion | +B2H+SWIP | +B2H+SWIP+Series Cap Insertions |
|---|---|---|---|---|---|
| Grizzly | -0.55% | -0.78% | +0.82% | -0.41% | +1.50% |
| Malin | -3.14% | -3.24% | -1.63% | -2.81% | -0.77% |
| Round Mountain | -3.25% | -3.30% | -2.10% | -2.85% | -1.25% |
| Table Mountain | -3.05% | -3.08% | -2.11% | -2.64% | -1.29% |
| Gates | -1.93% | -1.93% | -1.71% | -1.56% | -1.19% |

In this outage configuration, each 1% voltage deviation at Round Mountain is approximately 200 MVAr.

The Round Mountain 500 kV bus, given today's transmission system, deviates by 3.25% following the full loss of the PDCI. The voltage deviation is significantly reduced following the installation of B2H, SWIP North, and series capacitor insertion schemes. Based on these results, if the PDCI Bi-Pole outage is one of the limiting contingencies driving the need for 500 MVAr of dynamic reactive support as detailed in the CAISO Draft 2018-2019 Transmission Plan, this dynamic reactive support need could be reduced by as much as 400 MVAr following the installation of B2H and SWIP North.

## Conclusion – Further Enhancements to Economic Consideration #1 & #2

The combination of B2H and SWIP North would provide value to the existing COI system, and with the addition of the Hemingway – Cedar Hill segment of Gateway West, could provide a high-value geographically diverse contract path between the PNW, PacifiCorp, Idaho Power, and CAISO.

The B2H, and SWIP North projects, with added series capacitors for post-contingency insertion, is a simple concept to illustrate the way two major paths could coordinate and provide value to one-another while planning for low-probability / high-impact transmission outages. Idaho Power welcomes discussion with CAISO related to other opportunities that may be realized, such as pre-contingency balancing of COI and Idaho to Northwest through phase shifters, or other devices. There are many possibilities that could provide additional value, and allow both transmission paths to be more fully utilized for ramping and economic transfers.