Transmission's Future Today

High Capacity | High Efficiency | Low Profile

BOLD™

AEP AMERICAN® ELECTRIC POWER

BOLD™ – Breakthrough in Overhead Line Design

BOLD is a compact transmission line design that combines the advantages of higher capacity, lower energy losses, and a lower-profile structure with less visual impact. BOLD was created to maximize the use of land for transmission line corridors (right-of-way) and avoid complex specialized equipment like series capacitors that can create harmonic distortion that negatively impacts generator operations. The benefits that BOLD provides can help utilities achieve the objectives of new resource integration and infrastructure renewal with the highest efficiency and least environmental and community impact. The patented design, developed by American Electric Power, provides an efficient and robust transmission solution at common domestic and international voltage classes representing the best available technology in overhead line design.

Value of the BOLD Design

- BOLD has a cost advantage on a price/MW capacity basis versus traditional overhead lines, and is significantly less expensive than underground lines.
- BOLD avoids the need for costly and complex series capacitors that can create harmonic distortions that negatively impact generators.
- BOLD's lower impedance leads to reduced energy losses. Economic savings associated with reduced energy losses can be significant.
- The ability to replace and upgrade transmission lines with BOLD in existing corridors can save both time and money.
  There is also the ability to potentially reduce right-of-way width for new lines.
- The lower-profile aesthetic design has less impact on communities and view shed, potentially lowering public resistance to new or upgraded lines and helping to expedite the siting and construction process.

Key Advantages of BOLD Versus Conventional Transmission Lines

BENEFITS	BOLD 345 kV (3 Bundle)	BOLD 230 kV (2 Bundle)
Increased Capacity	**42%**	**59%**
Lower Tower Height	**(32%)**	**(23%)**
Lower Magnetic Field Levels	**(50%)**	**(48%)**
Lower Energy Levels	**(33%)**	**(7%)**
Lower Surge Impedance ***(Avoids Series Compensation)***	**(30%)**	**(37%)**
COSTS	**BOLD 345 kV (3 Bundle)**	**BOLD 230 kV (2 Bundle)**
Increased Material Cost	**20-30%**	**10-20%**

- Since BOLD is a new technology currently only under construction by AEP, cost comparisons are based on estimates developed by AEP and vendors involved in the first BOLD project in Indiana. The fabrication of the unique arched cross-arm is a new process that will become routine and less expensive as more lines are built. This is currently the primary factor for the cost differential.
- Conventional 345 kV designs often use a 2-bundle conductor, whereas BOLD uses a 3-conductor bundle which adds cost. However a conventional structure using a 3-conductor bundle would be nearly equivalent in cost without the same benefits.

Lower Cost per MW Capacity	**(7-17%)**	**(23-33%)**
Lower Delivered Cost per MW ***(Including Line Loss Savings)***	**(31-41%)**	**(29-39%)**

- BOLD is less expensive than conventional on a cost per MW basis. This also means fewer lines are required to achieve the same level of capacity.
- Savings associated with reduced line losses further offset up-front material cost.

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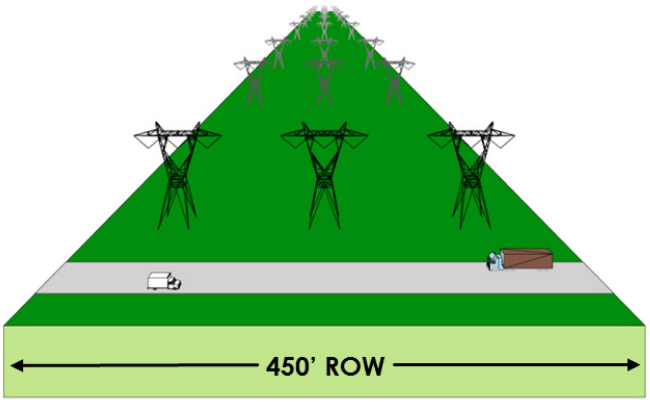
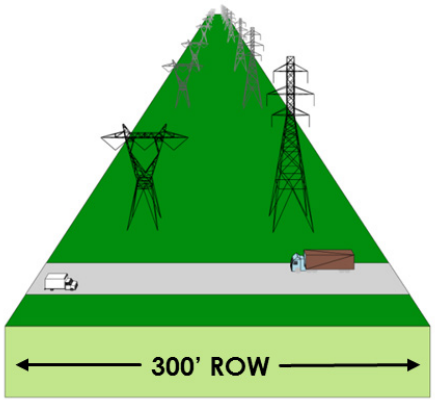
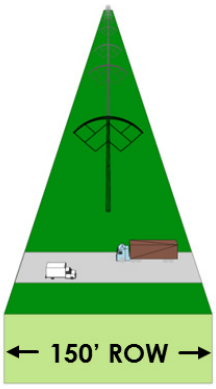
BOLD Provides 40-60% More Capability in the Same Right-of-Way



345 kV Traditional
(3) Single Circuit Towers
(1) Double Circuit Tower



345 kV Traditional
(1) Single Circuit Tower
(1) Double Circuit Tower

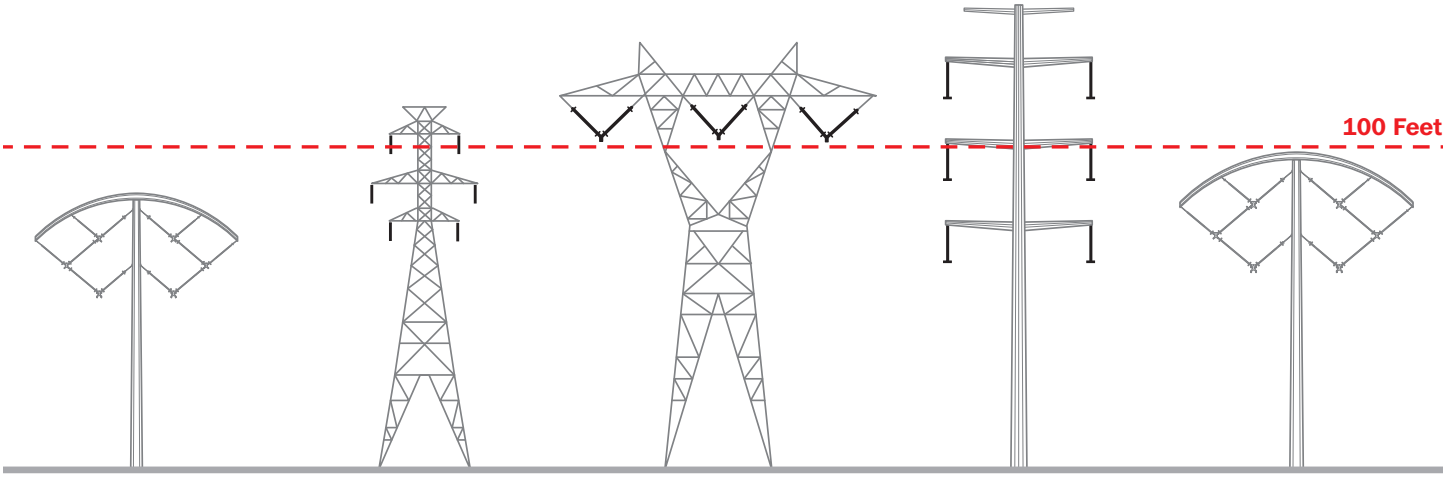


345 kV BOLD
(1) Double
Circuit Tower

Right-Of-Way-Opportunity

There is an increasing demand to maximize existing right-of-way that BOLD answers. BOLD can replace existing, aging low-voltage lines without any additional view-shed impacts. This creates a tremendous value when considering difficulties with siting and public opposition to new construction. Utilities around the world are looking at existing lines as possible corridors for future demands. BOLD simply does more with less compared to conventional designs.

Low-Profile BOLD Towers Reduce Visual Impacts



230kV
Tubular BOLD
Height: 87'

230kV
Lattice
Height: 113'

500kV
Lattice
Height: 130'

345kV
Tubular
Height: 145' 6"

345kV
Tubular BOLD
Height: 99'

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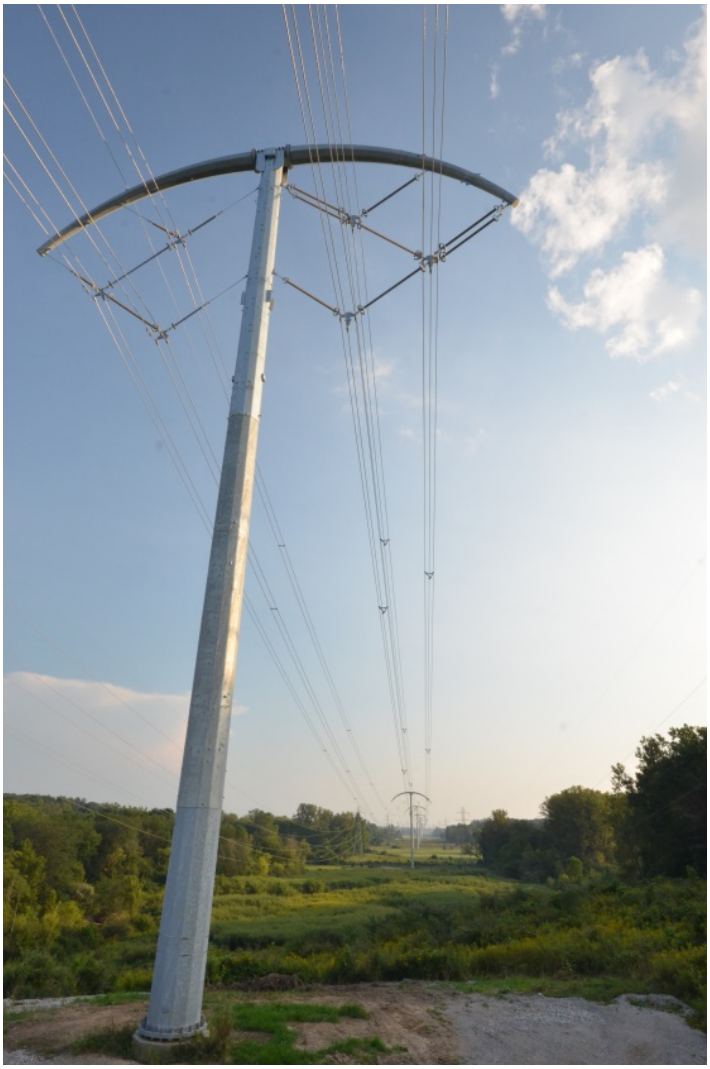
Connecting Renewable Energy

With the retirement of fossil fuel generators and migration toward new renewable generation facilities, new transmission lines must be constructed. BOLD is a perfect fit for these applications.



Series Compensation & Harmonics

Wind resources are generally located far away from the areas demanding power, thus requiring long transmission lines for transport. Historically, series compensation has been utilized to increase transfer capability on these lines for performance needs. Series capacitors can create harmonic interference known as Sub-Synchronous Resonance (SSR) which can interfere with and even damage turbine generation facilities . Series capacitors are also complex and costly. BOLD's compact line design, not requiring series compensation, is able to perform equal to or better than a traditional line with series compensation and avoid this potential complication

BOLD facilitates renewable energy through:

- Providing more capacity over longer distances
- Avoiding series compensation that can interfere with wind generators
- Increasing voltage stability
- Lowering energy losses

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BOLD™ – Deployment

American Electric Power is currently constructing the first BOLD transmission line project near Fort Wayne, Indiana. This initial deployment is built as a 345 kV/138 kV hybrid tubular steel design. The BOLD double-circuit tower replaced an existing 138 kV tower in the same corridor.

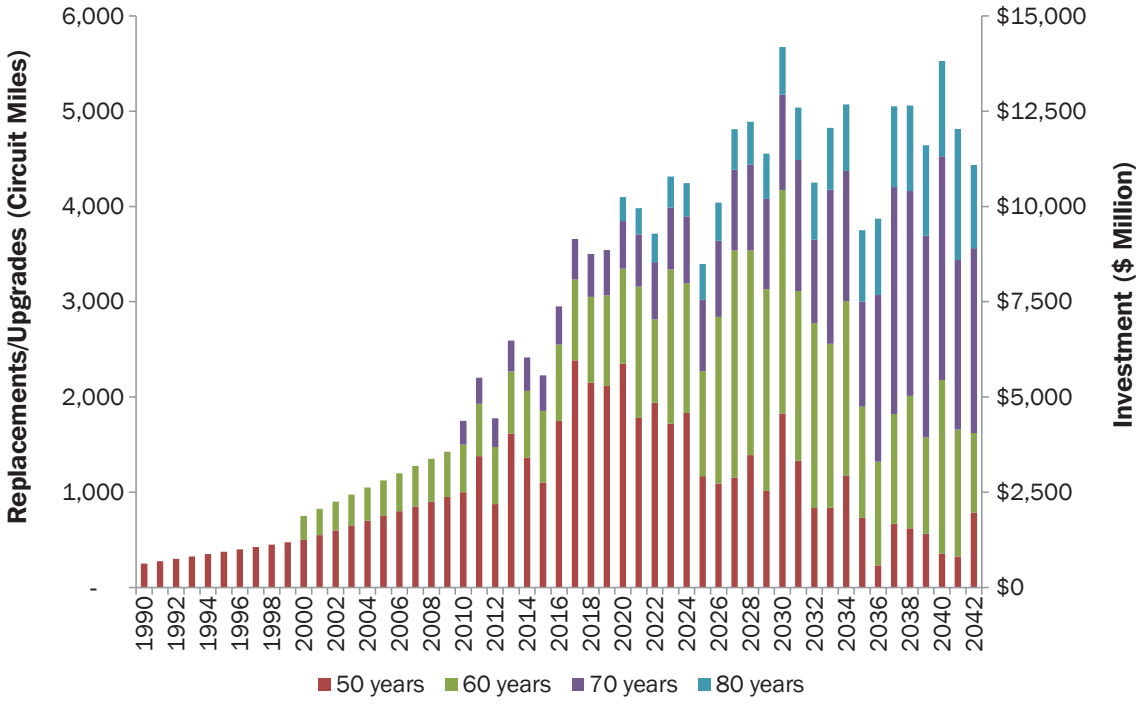
The second BOLD project, utilizing lattice tower structures, will be constructed near Lafayette, IN beginning in 2017.

BOLD Project – Fort Wayne, IN – March 2015

Worldwide Applications

BOLD is currently designed for voltages ranging from 200 kV to 400 kV, with future voltages classes under consideration. Over 125,000 miles of 345kV and 230 kV transmission lines are in operation today in North America. Many of these lines will be reaching the end of their useful life in the coming years, creating an opportunity to replace and upgrade existing infrastructure with new technologies such as BOLD.

Projected Circuit Miles Replaced/Upgraded and Total Projected Investment ($m)



Source: The Brattle Group, December 2014, "Dynamics and Opportunities in Transmission Development"

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Resource Links:

- Engineering Information available in October 26, 2015 Transmission and Distribution World Magazine:
  - http://tdworld.com/overhead-transmission/aep-s-bold-response-new-industry-challenges
- BOLD Website:
  - http://www.boldtransmission.com
- AEP Transmission Website:
  - http://www.aeptransmission.com
- NARUC Technology Webinar:
  - http://www.naruc.org/Publications/NARUCTDTechnologyWebinarSloanWilcox8%2021%2015%20(2).pdf
- Subsynchronous Resonance (SSR) Information:
  - http://www.elforsk.se/Global/Vindforsk/Konferenser/HF_symposium_111206/Gotia_Power_V309_subsynchronus_resonence.pdf
- Information on Age, Cost and Projected Replacement of US Circuits:
  - http://www.brattle.com/system/publications/pdfs/000/005/089/original/Dynamics_and_Opportunities_in_Transmission_Development.pdf?1417535596

Simulation of BOLD 345 kV Compared with a Conventional 345 kV Monopole

How can BOLD work for you?

The BOLD technology is available through licensing and other collaborative arrangements.

For More Information, Contact:

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