Reconductoring, Rebuilding, and New Transmission Line Applications for the ACCC® Conductor

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“Introduction

The increasing demand for reliable and efficient electrical power transmission has driven the need for innovative conductor technologies. The ACCC Conductor is a state-of-the-art solution that addresses key challenges in power transmission. Developed as an alternative to traditional steel-reinforced ACSR and ACSS conductors, the ACCC Conductor offers superior electrical and mechanical properties, making it an ideal choice for reconductoring existing transmission lines and rebuilding or deploying new transmission lines. To date, the ACCC Conductor has been selected for more than 1,450 projects in the United States and 67 other countries representing over 120,000 miles of proven performance since 2004.

General Advantages of ACCC® Conductor

The ACCC Conductor features a composite core composed of carbon and glass fibers embedded in a toughened thermoset epoxy matrix. This technology replaces the conventional

steel core used in ACSR and ACSS conductors. This advanced design provides several key benefits:

1. **Higher Capacity and Efficiency:** The ACCC Conductor can carry up to twice the current of a similarly sized ACSR conductor due to its higher thermal limits. While ACSS conductors also have higher thermal limits compared to ACSR, the ACCC Conductor incorporates 28% more conductive aluminum without a weight or diameter penalty. The added aluminum content helps deliver more power, more efficiently with 25 to 40% lower line losses than either ACSR or ACSS under equal load. Reduced line losses reduce fuel consumption and associated emissions while freeing up generation capacity otherwise wasted.

- **Reduced Thermal Sag:** The ACCC Conductor's composite core has a lower coefficient of thermal expansion compared to steel, significantly reducing thermal sag to help maintain safe clearances even under high-load conditions. Reduced sag can also enable the utilization of fewer and/or shorter structures (with smaller foundations) that can lower capital costs and shorten construction timeframes.

- **Improved Wildfire Safety:** Reduced sag and cooler operating temperatures can also reduce the risk and impact of wildfires. The ACCC Conductor's composite core also has a very high heat capacity, which, combined with improved clearances, can improve wildfire survivability. In contrast, hard drawn aluminum used in ACSR conductors can weaken when exposed to the heat generated by wildfires and galvanized steel can quickly degrade – both of which can require conductor replacement at substantial expense.

- **Improved Corrosion Resistance:** Unlike steel-core conductors, the ACCC Conductor's composite core is immune to galvanic corrosion, enhancing the longevity and durability of the conductor.

- **Greater Strength:** The ACCC Conductor's greater strength, thermal stability, and outstanding resistance to vibration and cyclic load fatigue allows for longer spans between fewer and/or shorter structures, reducing environmental impact and viewshed, construction timeframes, and upfront capital costs.

1. **Enhanced Mechanical Performance:** The high-strength composite core provides excellent tensile strength, enabling the conductor to withstand severe weather conditions such as high winds, ice loading, and debris impact. While different types of steel cores are available for ACSS conductors, their tensile strength varies from 200 to 285 ksi. In contrast, the ACCC Conductor's composite core is rated at 313 ksi with a higher strength, higher modulus ('ULS') version rated at 375 ksi. Another benefit is that the

ACCC Core is fully elastic and will not plastically deform, yield, or creep over time or after an extreme wind or ice load event. This ensures that sag infractions will not occur over the anticipated service life of 40 to 60+ years.

2. **Proven System:** While the ACCC Conductor is the most extensively tested and widely deployed Advanced (Carbon fiber core) Conductor in the world, it is noteworthy that the ACCC Conductor uses a collet system inside conventional compression hardware to effectively grip the core with very low strain. Unlike compression only alternatives, CTC Global's ACCC Hardware design ensures a lifetime of worry-free performance. To date, over one million of these devices have been deployed without a single failure.

ACCC® Conductor for Reconductoring Projects

- Reconductoring existing transmission lines with ACCC Conductors is an effective way to increase capacity without replacing or extensively modifying existing structures. This approach provides several advantages:
- **Increased Line Capacity Without Tower Modifications:** ACCC Conductors of any size (and equivalent weight) can carry twice the current of a conventional all aluminum or steel reinforced conductor. While ACSS conductors were developed as a higher capacity alternative to ACSR, their sag performance is very similar to ACSR, and they typically 'sag out' before they reach their rated ampacity. The ACCC Conductor has been used by Southern California Edison and several other well-known utilities to replace ACSS conductors after only a few years in service. In most cases, ACCC Conductors have been selected to replace existing ACSR conductors to increase capacity, mitigate sag infractions, and improve reliability – as ACSS and larger ACSR alternatives were not considered to be economically viable.

- **Reduced Downtime and Costs:** Reconductoring with ACCC Conductor can be completed faster and with less environmental impact compared to rebuilding or constructing new transmission corridors. Fast installations allow crews and equipment to be deployed elsewhere as needed, saving time, money, and valuable resources.

- **Compliance with Regulatory and Environmental Requirements:** By utilizing existing rights-of-way, utilities can avoid lengthy permitting processes and minimize environmental disruption. Reconductoring is generally completed under maintenance categories with minimal permitting and quick approvals.
- **Improved Grid Reliability and Resilience:** Upgrading aging infrastructure with ACCC Conductor enhances the overall reliability of the grid by reducing line losses and increasing efficiency. The ACCC Conductor's higher capacity can also mitigate grid

bottlenecks and allow operators to reroute power around problematic areas and/or planned or unplanned outages.

ACCC for Rebuild Projects and New Transmission Lines

Beyond reconductoring, ACCC Conductors are also highly suitable for rebuild and new transmission line projects of varying voltages and lengths. Their versatility allows for applications across a range of project requirements:

- **Reduce Capital Costs:** While ACCC Conductors are more expensive on a per foot basis, their costs "per amp" are comparable to much larger ACSR and ACSS conductors that meet any given load requirement. The ACCC Conductor's greater strength and reduced sag can allow increased spans between fewer and/or shorter structures. This can more than offset any cost delta and reduce construction timeframes. The impact of these advantages can be accentuated based on factors like terrain, labor costs, and other project specific variables. The ACCC Conductor's high performance and wide range of sizes also offers excellent design flexibility. For instance, when higher capacity is desired over improved efficiency, smaller, lighter, less expensive ACCC Conductors can be used to further reduce upfront capital costs. In any case, the ACCC Conductor's high capacity can generally accommodate peak loads and N-1 conditions while providing a means of future-proofing the grid without 'gold plating' it – as its improved efficiency is widely acknowledged by policy makers and regulators.
- **Reduced Lifecycle Costs:** The ACCC Conductor's superior mechanical performance and resistance to corrosion can reduce maintenance costs. Its embedded optical fibers (via the ACCC InfoCore® System) allow quick inspection before, during, and after installation – and *in the future* after severe storm events to ensure core integrity and safeguard system reliability.
- **Improved Efficiency:** Compared to ACSR and ACSS conductors of the same diameter and weight, the ACCC Conductor's improved efficiency can reduce fuel consumption and associated GHG emissions while also freeing up wasted generation capacity. While concerns about the costs of line losses and climate change vary regionally, freeing up wasted generation capacity to support growing demand greatly outweighs the cost delta of ACCC over ACSR or ACSS in any case. Reduced fuel consumption, directly or indirectly, benefits utilities, consumers, and the environment.
- **Long-Spans and Remote Installations:** Due to their lighter 'per amp' weight, high-strength, and ability to span longer distances, ACCC Conductors can reduce the need for intermediate support structures, making them ideal for projects in remote locations or with challenging terrains. ACCC Conductors have also been used for several major river crossings with spans as long as 1,600 meters (one mile). In one instance, ACCC

Conductor was selected to quickly repair a downed 533 kV DC line when one structure was washed out by a river.

- **Higher Voltages:** While ACCC Conductors have been selected for projects in voltages ranging from 11 kV to 1,100 kV, higher voltages generally require the use of bundled conductors to offset the impact of corona. In many cases, utilities in the U.S. and abroad have selected ACCC Conductors in single, double, triple, or quad bundled configuration to reduce the overall number of phase conductors required. For instance, NV Energy (who has completed over 30 ACCC Installations) prefers single bundle ACCC over double bundled ACSR. This not only allows greater capacity but also helps reduce conductor and structure costs. In Bangladesh, PGCB selected quad bundled ACCC for several long distance 400 and 500 kV lines with very long spans due to its outstanding strength, efficiency, capacity, reliability, and resistance to corrosion.

Conclusion

- The ACCC Conductor represents a transformative advancement in transmission line technology, offering significant advantages over traditional conductor options. Its superior efficiency, reduced sag, and corrosion resistance make it an ideal solution for both reconductoring aging infrastructure and rebuilding or constructing new transmission lines at various voltages and distances. As the demand for reliable and sustainable energy grows, ACCC technology continues to play a critical role in modernizing the grid and enhancing power delivery efficiency.

About CTC Global and ACCC® Conductor Suppliers

CTC Global (formerly Composite Technology Corporation) is headquartered in Irvine, California. CTC Global currently operates five ISO certified core production facilities in the U.S., India, China, Paraguay, and Indonesia. The core is shipped to any of 35+ authorized and licensed conductor manufacturing partners, worldwide, which supply finished ACCC® Conductor to their customers. ACCC® Hardware is produced by 11 authorized and licensed hardware manufacturing partners. CTC Global supports all end users through its Business Development, Application Engineering, Field Service, and Customer Service departments 24/7. For more information, please visit www.ctcglobal.com or email info@ctcglobal.com “

Representatives of CTC Global were at the three ISO-NE PAC meetings at which the X-178 was presented/discussed. It is not clear to me why none of them commented on the mis-statements made by Chris Soderman (Eversource) about why ACCC conductor would not work as an alternative to Eversource’s standard heavy, high-sag ACSS conductor and complete rebuild of the X-178 and easement.