Improving on the Original Westinghouse Iso-Phase Bus Design

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By Del Williams

Isolated-phase bus (IPB) systems are the critical first link in the power transmission chain.

As a highly reliable method of construction for moving bulk electrical power, Iso Phase Bus Duct systems are the superhighways that carry a power plant's very large amperage between the generator's output bushings and its associated main step-up (GSU) transformer. IPBs are typically rated from 6,000 to 45,000 amps with lower amperage tap connections to excitation and auxiliary transformers as may be needed.

Given its critical role, IPBs must provide a very high degree of rugged reliability and fault avoidance to keep power generation facilities operational without outages, downtime or severe equipment damage. Failure is simply not an option.

By its very definition, IPBs are designed to provide protection from faults by carrying each phase of current

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on a conductor mounted within its own separately enclosed, grounded metal housing. The conductors are usually hollow aluminum tubes supported within the housing on, hung or between stand-off insulators. Due to the heat generated, the housings may be self-cooled or force-cooled so that the IPB always operates within the maximum allowable top temperature as specified by IEEE/ANSI.

For decades, IPBs have been based on original designs from the major OEMs such as General Electric (GE) and Westinghouse that dominated the marketplace. Despite the exit of both GE and Westinghouse from the IPB market, some of the original designs live on through direct successor companies.

One such successor company is Crown Electric Eng. & Mfg. LLC of Middletown Ohio. Originally founded by the former Westinghouse plant general manager and material manager, Crown Electric engineers, designs, fabricates, installs, maintains, repairs and uprates Iso Phase Bus and large bus duct systems.

After purchasing ownership from Crown Electric's founding generation, the current owners of Crown invested heavily to build and equip the newest and perhaps most modernized IPB factory in North America in Middletown, Ohio–just a short drive from the old Westinghouse location.

Unique Insulators and Insulator Mounting Systems

Among the design features that are critical to IPB's are the support insulators that hold the heavy-gauge, high amperage conductors in place. These electrical stand-offs must withstand high temperatures, worse case mechanical fault forces and electrical stresses regardless of the IPB's operating conditions and environment. Salt, moisture, coal dust and ambient particulate can all be present and potentially accumulate within the housing.

In the IPB design from Crown Electric, high strength, high creep porcelain insulators are used to provide better resistance against tracking to ground. The insulators also have carefully chosen dew point ratings so as to eliminate potential failures associated with environmental moisture and condensation. This totally passive "belt and suspenders" approach ensures this modern version of the Westinghouse design never loses its nameplate rating.

If IPB conductors could magically be suspended in the center of the housings, voltage withstand would never be an issue. But until that time comes, stand-off insulators are required to center and support the IPB conductors.

Because each IPB support insulator is ultimately a potential point of tracking, each additional insulator also statistically increases the potential points of creepage paths to ground (due to dirt or a crack) and failure. In other words, the fewer the number of insulators, the higher the reliability. By maximizing insulator strength to control both static and fault forces, the required number of points for mounting and points of possible tracking are minimized.

Continuous Housings

Continuous housings are fabricated from lightweight aluminum sheets rolled and then seam welded to the appropriate diameter for each rating. Cylindrical sections are butt joined by various perimeter welding techniques to maximum strength and conductivity, creating an effective weather tight enclosure that protects conductors and support insulators from the surrounding environmental conditions. These lightweight IPB sections are specifically engineered to be shipped in the greatest practical lengths with fewer joints to field weld.

Unlike older non-continuous designs, continuous IPB has more inherent rigidity and structural strength, creating a self-supporting framework. Simple hangers or mounting feet (aka – "saddles") can easily carry the weight of long IPB spans.

With a continuous IPB design, the enclosure acts as its own ground plane, eliminating the need for a separate ground bus. The enclosure is at ground potential over its entire length so a single connection to the station ground can usually provide complete grounding.

A continuous housing design eliminates the electrically isolated sections associated with older non-continuous designs. As there is no voltage potential between enclosure sections, failures due to inter-sectional arcing is eliminated.

The continuous house design also inherently neutralizes its own conductor flux; thereby shielding nearby support steel and control wiring from the severe magnetic effects of stray loss heating and unintended control signal impingement.

With power generation facilities so dependent on reliable IPB systems, plant engineers and maintenance managers have a responsibility to ensure serious faults will not occur that can harm personnel or connected capital equipment. By taking advantage of significant Crown Electric design improvements that build on the already reliable, well established Westinghouse foundations, Iso Phase Bus duct has never been more rugged or reliable.

About the author: Del Williams is a technical writer based in Torrance, California. He writes about energy, health, technology and educational issues and holds a Master's in English from CSU Dominguez Hills.