Boise Data Center Guarantees 100 Percent Uptime

All-Copper Grounding Systems Ensure Reliability, Lower Maintenance Costs

Among Involta's newest-generation data centers is this 31,400 square feet facility in Boise, Idaho. The colocation center targets clients who opt to outsource mission-critical services, along with IT consulting and management, in order to concentrate on their core businesses. The center initially comprises two 100-cabinet data halls but was built for a several-fold increase in capacity. Like other Involta data centers, the facility features a robust all-copper grounding system coupled with a full-area lightning protection system. And, like a growing number of mid-sized data centers, it was designed and built to maximize electrical energy efficiency.

Involta is a Cedar Rapids, Iowa-based company that designs, builds and operates mission-critical-class data centers. Founded in 2007, the company operates 11 centers in six states[1]. It targets clients looking for the flexibility, security and economy of a full-service colocation center including IT consulting and management.

Among Involta's latest-generation centers is a 31,400 square foot facility located in Boise, Idaho **(Cover Photo).** Commissioned in December 2014, the center was built with an initial capacity for approximately 150 cabinets drawing 2.5 MW at full load. It can expand to nearly four times its current size and data capacity as business grows. It has two data halls, one of which is now operational **(Figure 1)**.

Involta creates and maintains the highest practical level of reliability at its centers to guarantee 100 percent uptime for its tenants. In data center terms, reliability means having lots of built-in *redundancy*, at least duplicate equipment and/or systems for any mission-critical need. Redundancy can be seen wherever one looks at Involta-Boise, and most of it involves copper.

FIGURE 1.

A portion of data hall No. 1 at the Involta-Boise data center shown shortly after the center's commissioning in late 2014. Most tenants prefer to cage their cabinets for additional security beyond that offered by the extensive systems in place at the center.

[1]Iowa, Ohio, Idaho, Minnesota, Arizona, Pennsylvania

FIGURE 2.

The Boise center is supplied with two 2.5-MW/12.7-kV feeds. Power is fed to the center via two independent, redundant feeds labeled "Blue" and "Red".

FIGURE 3.

One of two 2500-kW, 13.5-kV/480-V utility transformers serving distribution switchgear in one of the Boise center's data rooms.

Redundant Power System

Jeremiah Hinkle has managed Involta's Boise data center since it opened. He can point out redundant equipment and systems literally from top to bottom.

"I should start by explaining that we have independent dual power feed systems that extend all the way from the Idaho Power substation **(Figure 2)** to the customers' racks," Hinkle said. "We chose to label them 'Red' and 'Blue' feeds and color-code them accordingly. Most other centers use 'A' and 'B' terminology.

The substation supplies the center with up to 2.5 MW at 12.7 kV. Power is fed to two step-down utility transformers **(Figure 3)** that are individually dedicated to one power room apiece, supplying 480 V to our main distribution switchgear. The facility has additional transformers inside the power room to step power down to 208 V for distribution to the data hall and 120 V for the office.

Power enters the facility as the two Red and Blue feeds. In the event that we do experience a utility failure, we've implemented and installed a tie-breaker system in our power rooms so that if we happen to lose our Red utility feed, for example, that tie will close and the Red bus will be fed through the Blue switchgear. It works well."

Hinkle explained that distribution from the power rooms to the customer occurs through two power modules that Involta provides.

"Customers provide their own dual power distribution units to support their IT equipment," Hinkle said. "We use Starline™ busways **(Figure 4)** which enable technicians to add or change equipment quickly without relying on traditional connections. All-copper conductors in the busways supply three-phase power to customers at 208V/225A, which is sufficient for any expected requirements. We try to split the load evenly and never get above 50 percent on either of the dual circuits, so in the event that there is a failure in one of those feeds, the alternate busway can support the IT load on that particular rack or row of racks."

Starline busways are also used in the carrier room, which houses servers for outside vendors such as internet service providers, telephone and communications networks, etc. Racked equipment is bonded to traditional copper busbars installed on a portion of the racks overhead **(Figure 5)**. Double-screw lugs ensure the long-term reliability of equipment bonding connections. Where Starline or conventional connections are used, the racks themselves are also robustly bonded **(Figure 6)**

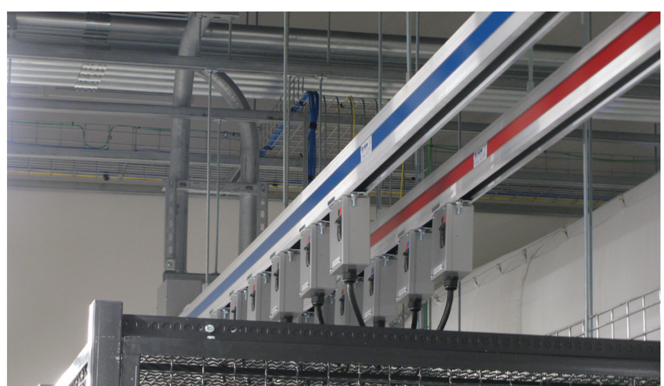

FIGURE 4.

Red and Blue power feeding equipment via Starline busways. The compact busways enable rapid connection of attached IT equipment. The busways shown are rated at 208V/255A.

FIGURE 5A.

FIGURE 5B.

Equipment racks in the relatively small (compared with data rooms) carrier rooms are also connected via busway (Figure 5a). Grounding connections are made to a copper grounding bus located above the stack of cabinets in the racks (Figure 5b).

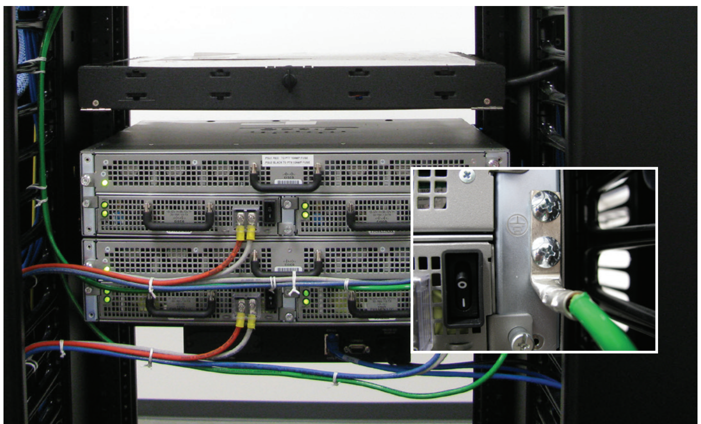

FIGURE 6.

Equipment mounted in racks. Green wires are routed to the left of the figure and up to the Starline buses. Insert shows green wire with double-screw attachment lug.

Back-Ups

The center is equipped with two, 1-MW emergency generators serving the Red and Blue power feeds, respectively **(Figure 7)**. The generators are load-tested monthly and no-load tested weekly, with results carefully documented. Should there be a utility failure and one generator simultaneously goes down, the second backup generator can support the critical load. Backing up the power feeds to the data halls are two 500 kW-UPS units equipped with sufficient battery capacity to keep the critical load operating for 50 minutes based on the current critical load.

One beneficial feature of the dual "Red" and "Blue" system is that it enables personnel to shutdown either feed if the other one requires maintenance or repair. Equipment on the system then remains completely operational and the center's 100 percent uptime is preserved.

[2]Placing mechanical equipment outside the data rooms contributes to the center's overall security since it restricts access to the data floor by mechanical tradesmen and others who might not fully appreciate the sensitive nature of the IT environment.

Cooling System Saves Energy

Involta has refined its data center designs over the years. "This is what we do as a company," Hinkle said. "At Involta-Boise, we decided to design our air returns a bit differently than those in our other data centers. At Boise, we actually built a four-foot-wide gap, or mixing chamber, between the data hall and the mechanical spine where the four, 25-ton Liebert DSE units reside **(Figure 8)**.[2] Cold output air from the Lieberts feeds into the mixing chamber. We placed return grates in the data hall up high near the ceiling so that the Lieberts constantly create a negative pressure — a vacuum effect — pulling the hot air in up high before injecting it into the four-foot mixing chamber. There, output from the Lieberts cools it and sends it back into the data hall to cool the customers' IT equipment."

The center utilizes a number of other energy-efficient practices, including LED lighting, motion-sensing light switches and efficient mechanical equipment, plus the ability to incorporate free-air cooling when outdoor temperatures permit.

Does it work?

Absolutely. Hinkle proudly notes that the center's power utilization efficiency (PUE) is between 1.4 and 1.6, which is remarkably low for a center like Involta-Boise.

PUE is the ratio of a facility's total energy consumption to the amount of energy sent to IT equipment. Total energy includes such functions as heating and cooling, lighting and office. A "perfect" PUE rating, obviously unobtainable, would be 1.0.

$$\text{PUE} = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}}$$

While PUE has several shortcomings as an energy-efficiency metric, it is still widely used in the data center industry.

"This facility really has exceeded my expectations," Hinkle said. "In the beginning, my goal was to operate at 1.5 PUE. Typically, at older data centers, you see a 2.0 PUE. To be lower than that is good, but in my opinion to be at a 1.5 to 1.2 is incredible."

FIGURE 7.

Involta – Boise is equipped with two 1 MW emergency generators, either of which can supply the critical loads in the entire center.

"Textbook" Grounding and Lightning Protection

Unfortunately, even in modern data centers, electrical grounding and lightning protection are too often treated as afterthoughts. That's not so at Involta centers, and certainly not at Involta-Boise, where grounding is especially robust throughout the facility.

- There is ***one*** grounding system with uninterrupted electrical continuity throughout the entire center. All of the center's electrical equipment, including IT equipment, therefore operates at a single, uniform ground potential. That *very* important feature is surprisingly easy to overlook.
- An AWG 2/0 buried bare copper ring ground completely surrounds the facility **(Figure 10)**. Bonded to the ring at periodic intervals are 10-feet X ¾-inch copper-clad grounding electrodes. Access ports along the ring allow for inspection of such items as lug tightness and ground resistance. All electrical and lightning systems are connected to this ring.
- Mechanical equipment, water, gas and telephone systems are properly grounded per National Electrical Code requirements. Mechanical equipment and IT systems do not share branch circuits.
- IT equipment grounding begins at the cabinets, where **#6 AWG or larger** green wires are firmly bonded to equipment cases using double-screw lugs **(Figure 6)**. Green wires are bundled and routed upward to Starline buses.
- Starline buses are used in the center's carrier rooms, where servers for internet service providers, networking and other communications companies are installed. Bonnding conductors are routed to traditional copper grounding bars attached to rack frames. The racks themselves are bonded to the copper bus with heavy-gage copper cables **(Figure 9)**.
- Heavy gage grounding conductors connect Starline systems with copper grounding bars placed at convenient locations in the data rooms and mechanical spine.
- Also bonded to the ring are copper down-conductors from the rooftop lightning protection system. It consists of interconnected, regularly spaced surge termination devices (lightning rods) mounted along the roof's periphery.

FIGURE 8.

Three of four 25-ton Liebert units supplying cold air for the center. Air is then mixed in a mixing chamber (insert) located behind the units (insert).

FIGURE 9.

Equipment racks themselves are bonded to copper busbars which serve the equipment cabinets and are then connected to the overhead busways.

FIGURE 10.

A 2/0 buried copper ground ring completely surrounds the structure, with 10 feet X ¾ inch tinned copper-clad vertical electrodes placed at periodic intervals. Note the inspection box to allow maintenance and testing.

That's a Lot of Copper! Is Copper Cost-Competitive?

The initial cost of copper cable is normally higher than aluminum cable of equivalent ampacity. But what seem to be simple economics in aluminum's favor, is strongly mitigated by the fact that electrical grounding conductors usually comprise less than one percent of a major technical construction project such as a data center. In addition, copper grounding conductors require far less maintenance (and lower labor costs) than aluminum systems. The red metal doesn't "creep" like the softer aluminum does; meaning that connections remain tight and don't require frequent torqueing to keep systems intact. Copper is also naturally corrosion resistant and represents a far less long-term deterioration. Taken together, those factors easily make copper the cost-comparative. All this means it's more reliable, a vital consideration at data centers.

"It may be cheaper up front to use aluminum, but it's going to be more expensive to maintain," Hinkle said. Inside plant at Involta-Boise, from downstream of the distribution switchgear to all the way out to the customer, our systems are all copper."

For more information about grounding and lightning protection systems, visit www.copper.org

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