CCG Insight

Electrical Load Bank Planning: Best Practices for Cx Testing

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Synopsis
The use of load banks, portable or permanent, during the commissioning process to simulate encountered electrical loads has many facets. Loads banks provide electrical loading (kW) as well as mechanical loading (BTU's). Utilization of load banks, their placement and loading, can be a complicated task. Careful consideration must be given to how, how much and when the loading should be engaged.

Discussion
Commissioning is a process comprised of many activities from Factory Testing through Integrated Systems Testing. Similarly, so does the use of load banks to simulate field conditions that are likely to be encountered once the facility is up and running. Logistics play a very important part in the decision of when, how and how many load banks will be used. The economics of load bank usage are not insignificant as the rental costs (for the portable load banks) can be relatively high (cabling is often more costly than the actual load bank itself) when used for a long period of time. Rentals are typically on the order of weeks (or in some cases months) along with labor costs associated with connection and disconnection. Let's consider the following items to keep in mind when designing a Load Bank Plan:

- Purpose
- Quantity
- Size
- Location
- Connection
- Duration

Purpose
Load banks can be used to satisfy many aspects of the commissioning process from electrical loading to mechanical loading. In electrical loading the goal is to view how various pieces of equipment response to electrical loads; connectivity; heating effects due to resistances, etc. Capacities of equipment will most likely be the highest priority – can the equipment sustain a particular 'full' load for an extended

period of time and continue to function as intended and can the equipment handle varying loads that are applied in to elicit particular responses and determine design thresholds.

There are two major categories of use to consider when selecting load banks. The first is for testing larger devices and systems such as generators and UPS systems. Load bank sizing could range from a few hundred kilowatts (kW) to tens of megawatts (MW). These units are often located outdoors but may need to be housed indoors (more likely the UPS systems) and special considerations to physical locations of the load banks and cables as well as heat rejection need to be considered. The second category is for use in testing of smaller devices such as Power Distribution Units (PDU's) and Remote Power Panels (RPP's). These are typically on the order of some tens of kW to a few hundred kW. The same considerations in terms of location and cabling as well as heat rejection apply.

From the mechanical perspective, the loading provided by the placement of the load banks is monitored in terms of the ability to dispose of the heat load generated. In other words, can the particular room or facility continue to function as intended with the heat load being imposed?

Quantity and Size

After one has determined what the purpose of the load bank(s) is, how much load will be required and how best to break the load up into discrete packets. Do we need one large load bank or is it more practical to use many smaller load banks to attain the same loading. As discussed, the purpose will usually dictate the quantity and size.

From a total load perspective, a single large load bank may present an easier way to install, position, connect and operate; it may not be the best choice. Diversity, particularly with mechanical heat loads, is more desirable. A concentrated load in one location would be more difficult to model and deal with since the cooling of a room is based on an overall room layout.

Location

This is probably one of the more difficult items to assess. It largely depends on how a room is configured both in terms of present conditions (which most likely means an open room with few if any obstructions) or future conditions (when a room is finally populated based on the design). One needs to take into consideration, more from a mechanical view, such things as hot and cold aisles, relative locations of CRAC units, locations of temperature sensors, and finally sprinklers. Too much heat in a concentrated area could inadvertently cause an operational sprinkler system to be activated with potentially disastrous results.

Connections

Where to connect these load banks is another difficult item to assess. One needs to take into consideration, the size of the load, the available electrical panel(s) and circuit breaker sizing. For mechanical load consideration only, whether or not the load should be connected to a source of uninterrupted power (UPS power) if one is testing a UPS system, where the power for the fans in the load bank should be connected. This latter item can have an undesirable effect on the load bank when power is lost – if the load is connected to a UPS system, but the fan is connected to a normal distribution system that is of the short-break type, the risk exists that the load bank could heat up and be damaged until fan power has been restored.

Overloading an upstream piece of equipment needs to be addressed. If a PDU is being used to supply power to a load bank through an RPP, one does not want to overload the PDU capacity and potentially the UPS system capacity (upstream). In addition, if the load banks need to be moved to different power sources and this shift needs to be quantified in terms of number of moves and time to make the moves.

Duration

This is often the question raised by those responsible for the cost of the load bank(s). The rental of load banks can be expensive in terms of the actual load bank and its attendant cabling and connections. In addition, if a large quantity of load banks are required, scheduling of their arrival on site and their departure times and dates are critical. For example, twenty (20) 100kW load banks may be needed on a specific date. They may not be available from a single supplier nor for the duration needed. They may not all arrive on schedule which can cause a delay in their usage.

Case Study

For a particular project recently undertaken by CCG, a quantity of thirty-two (32) 100kW, 120/208V load banks was required. These load banks were to be used to perform load testing of multiple PDU's (15) and RPP's through three (3) UPS systems. Loading was based on the capacity of the RPP's which limited the sizes to 100kW. In fact, the load banks are rated at 240V and therefore could only be loaded to a maximum of 65kW. The loading was then extrapolated up to the supplying PDU and then to the UPS system. The UPS systems had the capacity to handle the increased load as did the PDU's. Since this was an operating facility, it was necessary to install the load banks to test only the new RPP's and PDU's and locate the load banks in such a manner as to cause no significant heat load to the current operations. The assessment of the heat load was completed in two stages by first operating the load banks at 50% load (approximately 30-35kW) and then waiting a time to monitor any heat increases. When it was determined that there was no significant heat increase, the load banks were increased to 65kW each and the same assessment performed again.

The load banks were used in two waves of testing, the first wave was to ascertain the capacity of each of the PDU's. This did require multiple moves of the load banks. The second wave was using the load banks for mechanical loading. The testing was successful and provided the data necessary to verify the design.

Conclusion

Load banks provide a useful tool in which to simulate potential field conditions. Capacity testing of devices and systems can validate that the equipment will be viable for the operation of the facility. Sequences of operation can and will be tested with the use of load banks to insure proper operation of any load shedding or adding operations as well as the ability of the mechanical systems to react to changes in facility loading as designed.

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