White Paper

Medium Voltage Load Banks

ASCO Power Technologies®

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Facilities requiring high capacity loads are often served by medium voltage power, with a typical voltage range between 5 kV and 15 kV. When load banks are required for systems exceeding 600V, medium voltage load banks are specified. This document describes the types of medium voltage loads banks that are available and features that are unique to medium voltage applications.

TYPES of MEDIUM VOLTAGE LOAD BANKS

Leading load bank manufacturers offer medium voltage products in a variety of designs. The three most common designs are (1) Medium Voltage Load Banks with Step-Down Transformers on a common skid, (2) Containerized Medium Voltage Load Banks with an integral Step-Down Transformer, and (3) True Direct Connect Medium Voltage Load Banks. Each type is described in the following sections.

Medium Voltage Load Bank with Step-Down Transformer

A common configuration mounts a three-phase step-down transformer and one or more load banks on a structural skid, as shown in Figure 1. The transformer secondary voltage on these skid mounted units are usually rated at 480 or 600 volts. These higher secondary voltages result in lower current, and will require less interconnect cabling when compared to designs that use 208 volt or 240 volt secondary voltage.

Figure 1: ASCO Model 9830 Skid-Mounted Medium Voltage Load Bank.

In these skid applications, transformers must be weatherproof and rated for continuous outdoor use. All interconnecting cable is routed under the equipment through the skid, which avoids exposed cabling.

Specialized lifting equipment must be used to lift and transport these skid units. These logistical issues along with the practical limit on transformer size and weight, limit these designs to approximately 3 megawatts (MW). Skid-mounted units tend to offer purely resistive loads that operate at a unity power factor.

Containerized Medium Voltage Load Bank

Load bank manufactures often install large step-down power transformers and load sections inside 20-foot and 40-foot ISO-style containers. Unlike skid-mounted models, containerized load banks can offer both resistive and reactive loads, typically with power factors near 0.8. The capacity of the 0.8 PF medium voltage containerized load banks range between 4 to 5 MW.

Containerized medium voltage load banks are lifted from the top of the container and are thus more stable during lifting and transport. Because standard ISO shipping containers are available in lengths up to 40 feet, more equipment can be installed when compared to skid-mounted units. The ISO containers are weatherproof, and use “open core” step-down transformers that allow for smaller footprints and lower weights. A containerized model is shown in Figure 2. For additional information, see our white paper entitled Benefits and Applications for Containerized Load Banks.

Figure 2: ASCO Model 8800 Containerized Medium Voltage Load Bank.

True Direct Connect Medium Voltage Load Banks

True direct connect medium voltage load banks accept medium voltage power directly onto their input busses, and do not require any step-down transformers. The absence of transformers allows any additional space to be dedicated to increasing kW capacity. While typically offered in capacities up to 6000 kW, these units can sometimes offer higher capacities (depending on the application and the required voltages). This higher capacity can result in fewer units and lower installation costs when compared to containerized medium voltage load banks.

Direct connect load banks are designed for permanent outdoor operation, and feature lifting legs that raise the unit to provide sufficient air intake for cooling. Special resistive alloys are used in the load elements and the equipment is enclosed in custom-designed, non-metallic heater cases. Properly spaced air gaps are required to ensure that high-voltage currents will not arc from component to component.

Figure 3: ASCO Model 9100 True Direct Connect Medium Voltage Load Banks.

MEDIUM VOLTAGE APPLICATIONS

Turbine manufacturers, utility companies, and startup/commissioning services typically encounter applications requiring loads of 30 MW or more. To provide these loads, multiple high-capacity load banks can be paralleled to meet capacity requirements. In the 30 MW example, five 6 MW load banks can be paralleled to provide the necessary amount of load.

Commercial generator manufacturers now offer 15 kV rated models with outputs up to 10 MW. To support the maintenance, testing, commissioning, and start-up of these generators, medium voltage load banks apply sufficient load to mimic typical operation. In these applications, two 5 MW or 6 MW load banks can meet the need.

CONTROL of MEDIUM VOLTAGE LOAD BANKS

Skid-mounted and containerized medium voltage load banks offer a wide range of load control, load monitoring, and data capture options. Most major load bank manufacturers offer users the ability to control load banks using a hand-held controller, which is shown in Figure 4.

Figure 4: Digital Hand-Held Controller

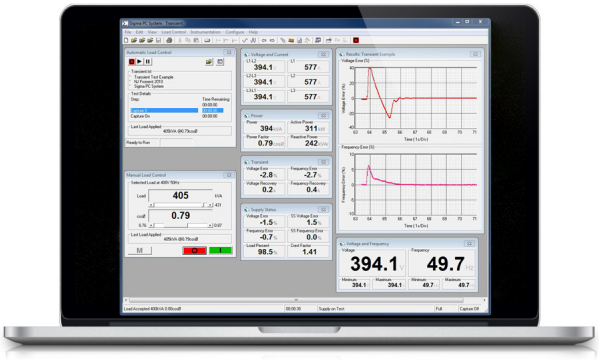

Figure 5: PC Control Software.

Alternatively, users can control load banks using personal computers or workstations equipped with a manufacturer's control software, as shown in Figure 5. Depending on manufacturer, some systems offer a wide range of communication, monitoring, control features including:

- Remote access and control
- Data logging
- Trend analyses
- Troubleshooting
- Automated Reporting
- Remote alarming and notification
- Interaction with building or power monitoring systems

These features offer opportunities to automate operation, provide real-time information to stakeholders, and streamline regulatory compliance. For additional information, see our white paper entitled, Advances in Load Bank Control.

Direct connect medium voltage load banks typically utilize either manual toggle controls, remote input/output interfaces, or dedicated programmable logic controllers. Most manufacturers offer systems that facilitate remote operation using customer-supplied control systems. These systems also use digital displays to present operating information and interactive controls.

Load Step Resolution

Load Step Resolution is the smallest change in load that can be affected by a load bank system. Skid-mounted and containerized medium voltage load banks typically offer resolutions ranging from 1 to 100 kW. For example, a 1000 kW skid-mounted unit with 50 kW load step resolution can add load in 50 kW increments.

Direct connect medium voltage load banks usually offer resolutions of 250 kW or more. For example, 6000 kW load bank with load steps of 500, 500, 1000, 2000, and 2000 kW, allows the operator to select any load level up to 6000 kW in 500 kW increments.

MEDIUM VOLTAGE SAFETY

Medium voltage load banks operate at 5 to 15 kV. These voltage levels require a higher degree of operator safety than those managed by low voltage units. Consequently, medium voltage load banks are designed with comprehensive safety features to help ensure safe and reliable operation. Common safety features include automatic load drop when intake cooling air is restricted or load bank exhaust exceeds design limits. The control and cooling circuits utilize fuse and overload protection to ensure current draw does not exceed design criteria.

To safely operate medium voltage load banks, operators must understand all of their safety features, learn associated work protocols, and observe all appropriate safety precautions. In addition, they must use personal protective equipment in accordance with regulatory and industry standards. Most load bank manufacturers offer operator training or can direct customers to qualified training providers. Manufactures can also provide load bank specifications, technical information, and methods for medium voltage testing.

SUMMARY

Medium voltage load banks are available in skid-mounted, containerized, and true direct connect models. The step-down transformer design (along with practical transport logistics) affects the maximum capacities of these units. Skid-mounted and containerized load bank can be controlled using hand-held or PC-based controls. The true direct connect design are usually controlled using customer-provided control systems, remote interface or via manual toggle switches. Advanced systems offer a range of real-time communication and control features that streamline work flows and enhance usability.

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