WHITE PAPER

Non-Segregated Bus Systems and Critical Inspection Components

The Difference Between Non-Segregated and Segregated Bus Systems

The bus duct system is the main conduit for power distribution in a power generation facility. Generally, there are two types of bus installations used in medium voltage applications: segregated and non-segregated.

Segregated bus duct systems house 3-phase conductors in a common enclosure, with each phase separated from one another by means of a metallic wall. These are typically used in applications requiring a higher level of safety. Non-segregated bus systems also house all 3 phases in a common enclosure. However, unlike the segregated system, all of its 3-phase conductors are separated from each other only by air.

There are several inherent comparative advantages between the two systems, and the choice is often made to meet the needs of the facility. Non-segregated bus duct systems are more popular and cost effective, whereas segregated systems offer a bit more reliability and safety.

The Key to More Uptime

As fast as demand on power is increasing, the tolerance for the downtime of any system is quickly diminishing. It's essential that power generation facilities invoke a proactive inspection and maintenance program to ensure that critical power transmission systems operate without interruption. The key to more uptime is preventative maintenance in a non-seg system.

System failures can occur from a variety of sources, including condensation, debris, dirt, poor grounding, cracked weld joints, and even improper installation. Proper inspections, cleaning and monitoring of your seg or non-seg bus system are crucial to creating a routine maintenance plan that will help to ensure parts are undamaged and equipment is running optimally.

The Process of Maintenance

Maintenance processes are often customized to each situation or facility. Such processes typically include:

Full diagnostics, which use a combination of approaches to identify weaknesses and damage, including a complete visual inspection, thermal imaging, EMI diagnostics, and Hi-Pot and Megger testing to identify damaged support insulators, corrosion, faulty bus connections, stray currents, defective insulation and damaged hardware.

Comprehensive analysis, which combines all data from the diagnostics to give the facility a full report on the findings.

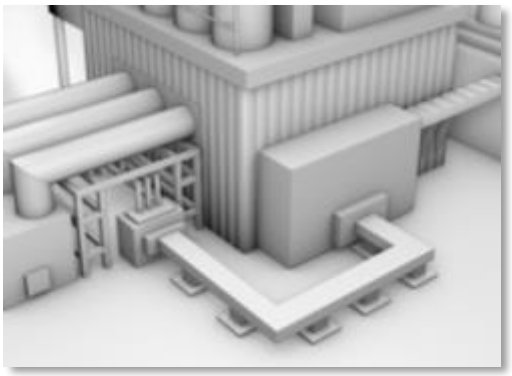
Proposed solutions, which outlines a prescribed plan to repair any damage or system weaknesses, ensuring proper material inventory before the job starts, as well as providing appropriate documentation.

Implementation, which executes on the approved solutions plan to perform the cleaning, repair, or replacement of any weak or damaged hardware, insulators and/or gasket material.

Testing, to ensure that the seg or non-seg bus system is properly restored and performing optimally.

Service Approaches to Non-Segregated Bus Maintenance

Non-segregated bus systems are not maintenance-free. However, plant managers sometimes make the assumption that such systems are self-maintained with little required attention or intervention. Nothing could be further from the truth. Non-segregated systems should be inspected, cleaned, monitored and maintained on a regular basis for optimal performance.



Typical service approaches to maintenance of non-segregated systems include:

- Removal of debris or other loose material from the (inside and outside of the) bus enclosure
- Cleaning bus walls, conductors and insulators (inside and out)

- (Re-plating of) terminals
- Check hardware torque and replace galled hardware
- Verifying ground connections
- Replacing damaged or aged insulators
- Inspect and/or replace braided connectors for fraying
- Replace gaskets from removed covers

Non-Segregated Inspection Components (Overview)

There are several critical components of non-segregated systems that must be inspected regularly and maintained proactively. These components include:

1. Terminations
   a. Surface conditions
   b. Silver plating
   c. Hardware (torque and uniformity)
   d. Flex connectors
   e. Insulation (taped or booted)

2. Conductor Splice Connection
   a. Hardware
   b. Adapter plates
   c. Contact surfaces
   d. Insulation (taped or booted)

3. Conductor
   a. Inspect insulation of conductor, which can be taped, noryl, or epoxy-coated
   b. Signs of tracking, heating or cracks

4. Rubber Enclosure Boots
   a. Look for tears, degrading, rotting

5. Enclosure
   a. Can be aluminum or stainless steel
   b. Look at hardware, gaskets
   c. Look for leaks (particularly on vertical sections)

Terminations

The connection assembly between the seg or non-seg bus duct system and any equipment (generator, transformer, switchgear, etc.) These are critical components that must be properly installed and maintained. The surfaces of these terminations must be properly silver-plated with no flaws in order to limit uneven conductivity and power flow.

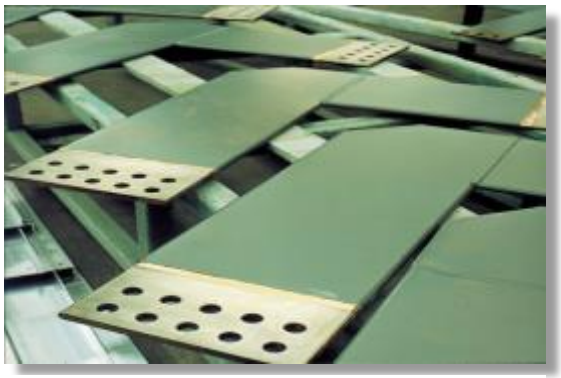
These terminations must be constructed uniformly to mitigate torque on the apparatus, and must have flexible joints to account for changes in temperature and vibrations while the system is operating. The terminations and enclosures must have electrical insulation at connections to generators and transformers in order to prevent longitudinal currents from flowing through generator frames or transformer tanks; this insulation can be taped or booted, and must be regularly inspected and properly maintained.

Conductor Splice Connections

All transition parts for connection to mating equipment terminals are typically provided by the bus manufacturer. Equipment connections can include flexible braided connectors, bolting hardware, bus adapters (where required) and insulating materials.

Terminals must ensure good connections without damaging conductors. To get good connections, over-torqueing must be avoided as contact resistance rises dramatically with over-torque. Conductor splice connections must be routinely inspected to ensure hardware is in good condition. Adapter plates must be smooth and undamaged, with contact surfaces that are free of obstructions or debris. Insulation (taped or booted) installed around splice connections needs to be in good condition without damage or gaps.

Conductor



Above: 1 Conductor bars for non-segregated systems.

The conductors within a segregated or non-segregated system can be either aluminum or copper, and can either be bar or extrusion. The conductor is one of the key elements of the system, and must be designed to withstand the electrical, mechanical and thermal forces imposed by electrical tests, continuous application loads, short circuit conditions, and shipping. Insulation of the conductor can be taped, noryl, or epoxy-coated, and must be regularly inspected for signs of tracking or heating to ensure maximum efficiency and mitigate or minimize systemic downtime.

Above: 2 Rubber bellow.

Rubber Enclosure Boots

The rubber enclosure boots are critical to the protection of the system against myriad technical issues, including short circuit forces, and thermal expansion and contraction effects.

Therefore, rubber enclosure boots must be routinely inspected for any sign of tearing, degrading, or rotting, which are common degradation issues with boots.

Enclosure

The enclosures of the system can either be aluminum or stainless steel. The enclosure is designed to house the entire system within, as well as facilitating the current flow between the independent phase conductors. Much like the conductors themselves, the enclosure must be designed to withstand mechanical and thermal forces, application loads, and short circuits. It is critical to maintain the enclosure by quickly identifying any leaks, particularly in the vertical sections.

RMS Energy Co, LLC is a professional nationwide construction and consulting firm with highly trained and experienced installation professionals who perform all aspects of Isolated Phase Bus (IPB) duct inspections and maintenance, including removal, reinstallation, retrofitting and testing. Our services also include cutting, aluminum welding, and transformer termination compartment removal, reinstallation, and provision of replacement parts. We work with the main bus manufacturers to deliver a turnkey solution to you. With an industry low EMR, our priorities are focused on safety, quality, schedule and budget.

RMS ENERGY CO., LLC
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