ABSTRACT

The purpose of this presentation is to educate the audience on best practices that have been identified for analysis, inspection, cleaning, and maintenance of the bus duct systems of the power generation facility. Many plant operations and maintenance managers ignore the bus duct system, forgetting it is a system critical component in the power plant that does not have redundancy AND is connected to expensive plant assets on both ends.

Common statements made before a bus duct failure include “It has no moving parts, what could go wrong with it.” Or, “It has run without issue since the plant was built, why do we need to open it up now?” And another common statement; “We inspect the exterior of the bus and do IR scans of the enclosure regularly.” Inevitably, plants that operate under any of these philosophies have or will experience a failure of their bus. This presentation will explain why.

The presentation will review numerous case studies from over forty years of field findings from Electrical Builders, Inc. (EBI). Presentation topics will include IEEE industry standards, inspection options (both online and offline), testing requirements, life extension options, current trends in predictive maintenance programs, the ramifications of poorly and/or inadequately maintained bus duct systems, and best practices for bus duct system inspection and maintenance.

INTRODUCTION

Overview of IEEE Standards:
IEEE Standard C37.23 – 2003:
Review of Standards and Purpose
• Limit of Specifications
• Applicable Ratings – Voltage
• Applicable Ratings – Withstand & BIL Level
• Applicable Ratings – Continuous Current
• Applicable Ratings – Momentary
MAIN COMPONENTS AND PURPOSE

There are a variety of different types of bus within a power plant. Isolated Phase Bus (IPB) can be continuous or non-continuous. Other variations include Segregated, Non-Segregated (Non-Seg), and Cable Bus. It is important to understand the purpose of bus duct systems in order to realize the critical roles they play within the generation facility and subsequently, the importance of properly inspecting and maintaining them on a regular basis.

INSPECTION OPTIONS
Online Technology and Inspection Options
Offline Options

TESTING REQUIREMENTS
Industry acceptable tests for your Isophase, Seg and Non-Seg bus systems

PREDICTIVE MAINTENANCE OPTIONS
Current Trends
Cost Benefit Analysis

RAMIFICATIONS OF POOR OR INADEQUATE MAINTENANCE
Case Studies and Field Findings

BEST PRACTICES – INSPECTION AND MAINTENANCE

Scope of Work
Approach – Examples of What to Look For
Partial list:
- Heating Issues
- Over-Torqued Bolted Laminate Ends
- Incorrect Torqueing
- Over-Heated Braids
- Compromised Enclosure Shunts
- Support Structure Issues
- IPB Adaptor Replacement
- Failed Laminates
- Internal Contamination
- Gasket Issues

Three Most Common Failures
1. Improper or Inadequate Design
2. Improper Installation or Maintenance
3. Failure of Other Connected Equipment
INADEQUATE DESIGN

Poor design is one of the most common issues found at the epicenter of bus duct system problems. The three most common design failures include inadequate access for maintenance, enclosure expansion joints using cables for grounding, and single insulator bus designs with the insulator supporting the conductor in suspension.

Most bus systems do not have access points that allow proper maintenance of the internal components. In some cases removable covers are provided on the opposite side of the support insulators that allow unbolting of the conductor from the insulator. This does not allow access to the insulator for inspection or cleaning. Another case is not having access on one or both sides of a Seal-Off Bushing. Dirty insulators or Seal-Off Bushings will cause tracking which will eventually lead to a failure.

One bus design uses sliding covers as an expansion joint for the enclosure. With this design a large number of cables are connected across the joint to carry the ground current. With these bolted mechanical connections the cable with the best connection carries a larger amount of the ground current because it has the lowest resistance. This cable will overheat and fail which shifts that current to the cable with the next best connection. As more and more cables fail the overheating and failure of the cables will accelerate.

Bus insulators used in suspension inside the IPB are typically found in older systems. The vibration inherent in all generation equipment will degrade the ceramic inserts in the insulators. Failure of one or more of these insulators will result in added stress on remaining insulator supports and misalignment of expansion links and braids. This in itself can and has been shown to cause stress cracking/separation of laminates. On braids, this can cause misalignment and rubbing of the braids together which results in excessive wear on the braids and contamination of the IPB system from the metallic dust from the braids rubbing on each other. With top mounted insulators, if the insulator fails, the conductor is likely to fall inside the IPB causing a phase to ground short resulting in major damage to system.

IMPROPER INSTALLATION AND MAINTENANCE

Improper installation and maintenance is the second most commonly found issue with bus duct systems. The importance of having an experienced and qualified contractor cannot be understated. To emphasize this point, some manufacturers are starting to offer an extended warranty if you can prove that you had a qualified installer do the install and if you can provide documentation that you follow their maintenance recommendations. Case studies of improper installation and maintenance will be reviewed during this section as well.

FAILURE OF OTHER CONNECTED EQUIPMENT

Case Studies
Importance of Unified and Consistent Inspection and Maintenance Approach for “Bookend” equipment in conjunction with the bus duct.
Table 1: Isolated Phase Bus manufacturer maintenance recommendations

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Recommendation Maintenance Schedule</th>
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<tbody>
<tr>
<td>Delta/Unibus – Powell</td>
<td>Scheduled Shut-Downs or minimum every 18 months</td>
</tr>
<tr>
<td>AZZ/Calvert</td>
<td>Scheduled Shut-Downs or minimum every 18 months</td>
</tr>
<tr>
<td>GE</td>
<td>Scheduled Shut-Downs or minimum every 18 months</td>
</tr>
<tr>
<td>Technibus/ABB</td>
<td>Scheduled Shut-Downs or minimum every 18 months</td>
</tr>
<tr>
<td>ITE</td>
<td>Obsolete – Follow Industry Standards</td>
</tr>
<tr>
<td>Westinghouse</td>
<td>Obsolete – Follow Industry Standards</td>
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</tbody>
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BIOGRAPHY

Mohsen Tarassoly is the Director of Sales & Business Development at Electrical Builders, Inc. (EBI). Mr. Tarassoly is an electrical engineer, earning his EE degree from Penn State. He has over 25 years of experience in both the domestic and international power industry working with most major utilities, EPC’s, and engineering entities. His experience includes executive management roles with some of the largest OEM manufacturers of Isolated Phase Bus, Non-Segregated, and Segregated Phase Bus systems, including Powell/Delta Unibus and Technibus/ABB.

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