

# **Solid Insulation Iso-Phase Bus Bar And Applicable Governing Standards**

## **Technical Bulletin #104**

Solid Insulation (SIS), Iso-Phase Bus Bar has been in wide spread use throughout Europe, Asia and the Middle East for over 30 years. Its advantages as a fully insulated system for transmitting high currents at voltages up through 36kV is well documented and there is a wealth of experience in the number of systems in service and a proven track record of reliability of those systems. While SIS bus bar has been used as a direct replacement for traditional metal enclosed bus bar systems and insulated cable, the industry has been slow to develop a standard that specifically addresses the unique characteristics' of its design. The elements of the system however, utilize proven technologies that are employed on similar components that are governed by industry standards. This bulletin will cover the similarities between SIS bus bar and other systems that utilize similar design, manufacturing and testing principles.

### **Background**

At the heart of SIS technology is the use of a resin impregnated paper (RIP) insulation system applied directly to the main current carrying conductor, resulting in a maintenance free, fully insulated, touch safe, bus bar capable of operating up to 36kV. RIP technology has been in wide spread use in the electrical industry for medium to high voltage and EHV applications for over 50 years--mainly in the manufacture of high current RIP transformer bushings.

Consider some of the operating and design objectives of a high current, high voltage bushing.

- Fully isolate the high voltage conductor from the rest of the system.
- Minimize voltage stresses in the insulation system through capacitive grading.
- Ensure void free insulation to eliminate partial discharge and insulation degradation.
- Carry the full current while maintaining acceptable temperature rise.
- Ensure acceptable operating temperatures in the conductor and insulation as not to compromise material integrity and loss of life.

SIS bus bar can be thought of as a continuous RIP bushing that extends the reach from one piece of equipment to another. Instead of transitioning to another technology to accomplish the transmission and isolation of the current and voltage, i.e. insulated cable or metal enclosed bus duct, a continuous RIP system is employed to accomplish the connection.

### **Objectives of SIS Design, Manufacturing and Testing**

The specific operating requirements of the bus bar system will dictate the design parameters for the bus bar system. They include but are not limited to:

- Maximum system voltage and current
- Ambient temperature
- Routing and clearances
- Equipment connections and non SIS bus interconnections
- Indoor vs Outdoor installations
- Support structures to include seismic compliance

Once the bus bar segments are manufactured according the proven RIP processes for vacuum impregnation and resin curing, each and every bus bar segment and connection sleeve is individually tested according to IEC 60137, ***Insulated bushings for alternating voltages above 1 000 V*** (comparable to ANSI IEEE C57.19.00 and IEEE C57.19.01) to ensure acceptable test levels for power frequency, partial discharge, capacitance and loss factors. This test criterion is the essential element of verifying a void free insulation structure that will lead to partial discharge free operation.

All Ritz SIS Bus Bar voltage class designs and current capacity ratings have been verified through type testing procedures also covered under IEC 60137 according to the following test regimen:

1. Power frequency test and pd measurements.
2. Impulse voltage test.
3. Power frequency test and pd measurements repeated.
4. Temperature rise test
5. Temperature cycling.
6. Power frequency test and pd measurements repeated.



*Instrument Transformers*

## **CSA and UL Compliance**

As stated previously, presently there are no standards that specifically address SIS bus bar designs, manufacturing and testing, however, the CSA Standard C22.2 No. 273-11 for Cablebus Systems is considering incorporating the SIS concept into this standard and we expect to fully comply with this standard once a final draft is presented.

In the interim, there are procedures for applying CSA or UL labeling on a project specific basis. This certification is available should the end user wish to define a hybrid list CSA and/or UL compliance requirements that SIS must meet.

## **Conclusion**

Solid Insulation Iso-phase Bus Bar is a verified concept with a proven in service track record that spans four decades. It is an innovative solution to high current, medium voltage transmission challenges confronting design engineers.