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Plenary Lecture #2

Joining by Forming of Busbars for Electric Energy Distribution Systems

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Background

Busbars are electric grid components responsible for the transmission and distribution of energy in low voltage, high current, applications. In the case of electric vehicles, for example, busbars are responsible for supplying energy to electric motors, electric power steering systems and AC/DC converters, among other equipment. Busbars are commonly made from copper and their use is generally preferred to wires, and cables because of easiness of installation and maintenance, compactness, and safety. In recent years, the rising price of copper has been stimulating the interest in replacing copper cabling by hybrid busbar distribution systems made from copper and aluminum. However, the development of hybrid busbars raises several challenges due to the differences in the physical, chemical, and mechanical properties of copper and aluminum.

Procedure

The keynote is focused on the challenges related to the fabrication and thermo-electrical performance of the joints between the copper and aluminum conductors and introduces two innovative joining by forming processes to produce hybrid busbars joints (Fig. 1).

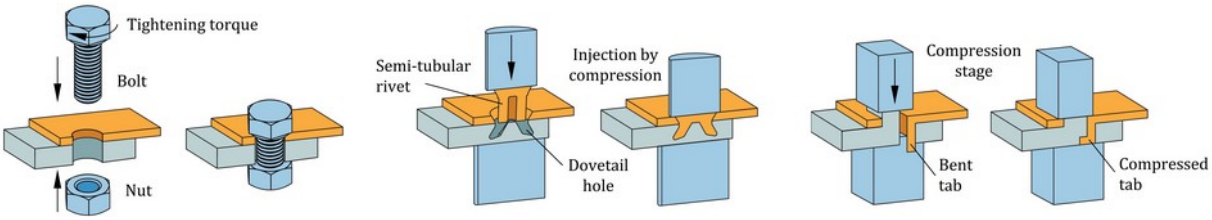

Figure 1. Fastened, injection lap riveted and sheet-bulk compressed hybrid busbar joints.

The thermo-electro-mechanical performance of the new joints was evaluated under laboratory-controlled conditions and compared with that of conventional fastened joints subjected to different tightening torques and surface preparation of the conductors. Experimental and numerical modelling using thermo-electro-mechanical finite elements allowed concluding that the new joints cause less disturbances on the electric current flow than the conventional fastened joints.

Conclusions

- The effectiveness of fastened joints is strongly compromised by unintentional self-loosening during the service life.
- Fastened joints with loose clamping forces subjected to salt spray tests allow the NaCl solution to penetrate the contact interface and dissolve the aluminum to form aluminum hydroxide.
- Further developments in injection lap riveted and sheet-bulk compressed hybrid busbars are required to lower electrical resistances to the levels of ideal joints having perfect contact and complete absence of roughness, contaminants, and oxide films on the overlapped region between the aluminum and copper conductors.