Study Committee B3

Substations and Electrical Installations

Paper ID 140

USE OF ADDITIVE MANUFACTURING IN THE MAINTENANCE OF STATIC COMPENSATOR

Alexandre PINHEL* - Brazil, Furnas Centrais Elétricas, pinhel@furnas.com.br
Leonardo PINHEL – Brazil, Royal IHC, l.pinhel@royalihc.com
Leonardo TUORTO – Brazil, Delta Thinkers, leonardo@deltathinkers.com
Heitor MENDES – Brazil, CEFET/RJ, heitor.mendes@cefet-rj.br
Sérgio GODINHO - Brazil, Furnas Centrais Elétricas, sag@furnas.com.br

Motivation

- Lack of spare parts for maintenance of a static compensator.

Method/Approach

- Analysis of failure modes due to leakage of the refrigeration system
- Adoption of Additive Manufacturing (3D printing) to produce the parts.
- Reverse engineering, material selection, part manufacturing and testing.

Objects of investigation

- Pressurized sealing system consisting of 4 parts as follows.

Insert: a pin inserted at the end of the hose with multiple sealing functions.

Sleeve: with a tapered end to provide sealing against the tapered end of the nipple.

Gripper: a conic contractible bracket responsible for holding the hose in place against the expulsion force generated by the pressure. It also transfers the axial force from the nut's tightening to the sealing components.

Nut: responsible for providing the tightening force necessary for the connector to work. It has as special feature a conic opening at the front face.

Experimental setup & test results

- Assessment of manufacturing technologies and materials compatible with the application.
- Test protocol definition.
- Selection of nylon as the most appropriate material, manufacture with FDM technology and tests with compressed air.

Discussion

- 3D printing provides design freedom that allows the creation of parts with greater sealing capacity, increasing the efficiency of the system.

Conclusion

- Solution was effective and cheap.
- Tests with compressed air proved to be simple, cheap and very conclusive.
- After testing phases, parts were produced for complete replacement of the refrigeration sealing system.
- This initiative provided knowledge for future applications in pressurized systems.
- Detailed description can be found in the paper.

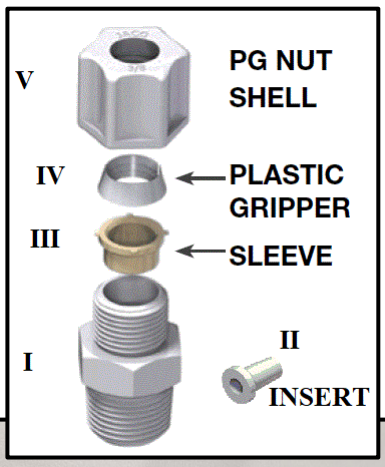
Study Committee B3

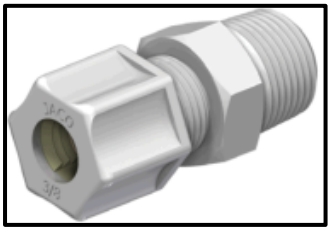
Substations and Electrical Installations

Paper ID 140

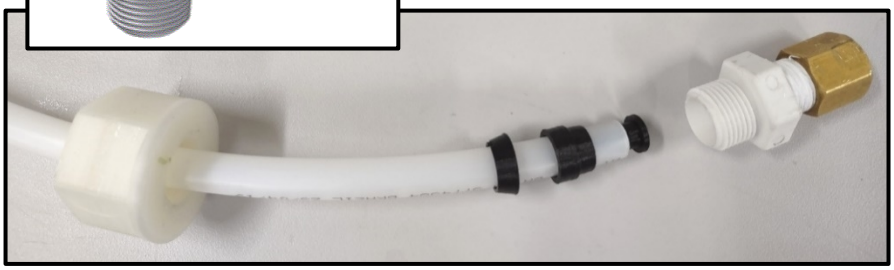
USE OF ADDITIVE MANUFACTURING IN THE MAINTENANCE OF STATIC COMPENSATOR

- General view of the thyristors system with the refrigeration connections in detail



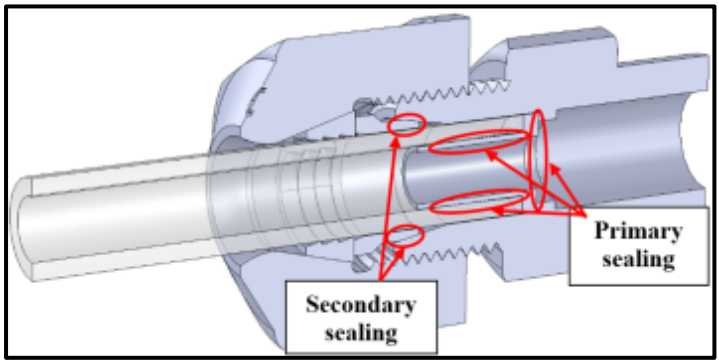


- Original connector from the catalogue and the 3D printed parts.
- Detailed description can be found in the paper.

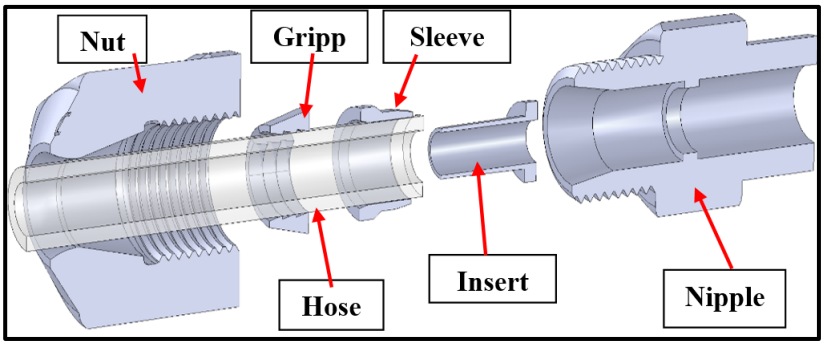


Study Committee B3
Substations and Electrical Installations
Paper ID 140

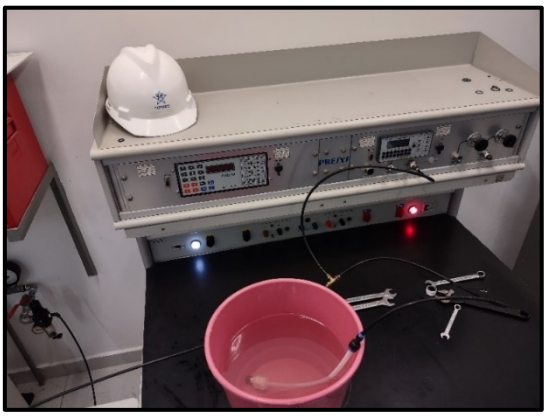
USE OF ADDITIVE MANUFACTURING IN THE MAINTENANCE OF STATIC COMPENSATOR



- Section view of the printed kit and its nipple (complete connector).



- Printed kit and its nipple, exploded view



- The compressed air testbeds at CEFET/RJ (left) and Furnas (right).