



### SEMINAR ANNOUNCEMENT

Politecnico di Milano – Sede Leonardo – Ed. 21 – Aula BIO1 – I Piano - Via Camillo Golgi, 39, Milano

Friday 7 September, 10:00 – 11:30

### **Extra/Ultra-high-voltage power transmission and transformation equipment and systems: safety operation technologies and protections**

*Y. Zhang, H. Weng, X. Huang - Three Gorges University, Yichang, China*

Reference: Prof. Luca Di Rienzo ([luca.dirienzo@polimi.it](mailto:luca.dirienzo@polimi.it))

The seminar will be composed by three presentations.

#### **Y. Zhang, Structure Optimization Design of a 1000kV UHV Shield Ring Considering Fatigue Fracture**

Some fracture failures in multiple shield rings on a 1000 kV Ultra High Voltage (UHV) transmission line were noted and the number of damaged shield rings increased year after year. In order to avoid crack enlargement, the operation and maintenance personnel adopted the method of reinforcing and welding at the fracture site. However, the reinforced shield rings were damaged again after half a year's use. A new approach is then proposed to extract the root cause. Using the wind load happening every fifty years, 15 mm ice coating and self-weight as the calculated load, finite element method is used to calculate the static performance of the shield ring. It is proved that the cause of the crack is not the ultimate strength failure of the materials. After acquiring the wind vibration frequency by a vibration image recognition method, the critical wind speed can be obtained by the vortex-induced resonance analysis. Based on the critical speed, the lift force function is formed. According to the historical load simulated by lift force function, the displacement and stress response under the vortex-induced resonance are obtained by transient dynamic calculation for the shield ring. With the help of regional meteorological data, the probability of the wind direction and the velocity within the critical vibration wind speed range are calculated. Then the displacement and stress response and the vibration frequency of the shield ring, the fatigue life assessment is analyzed. Inspired by the idea of the energy dissipation-seismic reduction, a new type of shield ring is designed. After testing the mechanical and electrical performance, the new one runs perfectly without emerging crack from November 2016.

#### **H. Weng, Operation Behavior and Novel Schemes of Protections in Converter Substations of UHV Transmission Projects**

In recent years, maloperations of the main protections in HVDC converter substations have been recorded. This indicates that the electromagnetic transient phenomena relevant to the main equipment protection within converter substations are becoming increasingly complex, which may affect the entire converter substation, leading to the decreasing of the reliability of HVDC transmission projects. The above-mentioned problems will possibly become more serious in the circumstance of Ultra-high Voltage (UHV) AC-DC deeply

coupling of future power grid. In this presentation the complex electromagnetic scenarios of main equipment protections due to the AC-DC deeply coupling are analyzed. The mechanisms of abnormal operations of the bridge differential protection, the converter transformer differential protection and the zero-sequence protection are revealed. By means of advanced signal processing techniques like Hausdorff image discrimination algorithm, novel schemes of the main equipment protections of converter substation are proposed.

#### X. Huang, **Safety operation distance detection for EHV transmission line**

During maintenance and repair work in power system operation, it is vital to keep certain distance between operation personnel and electrical power equipment, which, unfortunately, is now relying mainly on human observations. Due to human errors such as misjudgment or negligence, equipment damage and human casualties may occur. To meet the requirement of realtime safe working distance measurement, a distance measuring system based on high precision ultrasonic sensor using STM32 MCU as the core processor is designed for live working. Through wireless WiFi communications, the challenges of wiring with the device near high voltage charged equipment is obtained. The safety distance measuring system has effective safety protection functionality and can timely alert the operator. It increases the safety of personnel and equipment.

#### **Bio-sketches**

**Dr. Yujiao Zhang** was born in China, in 1979. She received the Ph.D. degree from the School of Electrical Engineering, Wuhan University in 2012. Currently, she is with the College of Electrical Engineering and New Energy, China Three Gorges University. In 2016, she became Doctoral Supervisor. Her research interests include advanced design and intelligent maintain of electrical equipment. She presided over two projects supported by the National Natural Science Foundation of China and tens of projects supported by electric power company. She is the author of 50 technical papers and 10 patents for invention. In 2017, she awarded First Prize of Science and Technology Progress in Hubei Province.

**Dr. Hanli Weng** received her Ph.D. degree in Electrical Engineering from the Huazhong University of Science and Technology, in 2009. She served as Senior Engineer in China Yangtze Power Company and is presently an Associate Professor with China Three Gorges University. Her general interests are in power system analysis and protective relaying – subjects on which she has published more than 50 journal and conference papers and 2 books. She has served as a reviewer for IEEE Transactions on Power Delivery, IEEE Transactions on Smart Grid, International Journal of Electrical Power & Energy Systems. She is currently involved in research on transient phenomena in power systems and its influence on the protective relaying under AC-DC deeply coupling interactions.

**Dr. Xiongfeng Huang** earned his Ph.D. in Control Science and Engineering from Huazhong University of Science & Technology, Wuhan, China, in 2015. He is associate professor in the School of Electronics and New Energy, China Three Gorges University, Yichang, China. His research interests include industrial communications and theory and application of Networked Control Systems and Safety Operation of Power Systems. He participated in several research projects of the National Natural Science Foundation and State Grid Corporation of China.