MMC Submodule Capacitor Health Monitoring Method

A solution to enhance the maintenance of the submodule

# CONTEXT

Modular Multilevel Converter (MMC) is today the preferred solution for HVDC AC/DC conversion. The MMC is composed of hundreds of elements called submodules (SM), typically made of a DC capacitor and two switches. The capacitor used in each SM has a typical capacitance of a few mF and should withstand a voltage of typically 1.6kV or 3.6kV depending on the breakdown voltage of the IGBT (3.3kV or 6.5kV), so Metallized Film Capacitor technology is preferred.

Even if this technology of capacitors is renowned, the return of experience on the HVDC-MMC in operation is limited. Each arm contains redundant submodules, calculated to ensure a 2 year period between scheduled maintenances. When all the redundant submodules in the arm have been used, the converter cannot be operated anymore and has to be stopped for maintenance.

# **APPLICATION DOMAIN**

• HVDC, STATCOM (every converter featuring submodules)

## **ADVANTAGES**

No additional sensor required Non intrusive method Real-time or off-line implementation

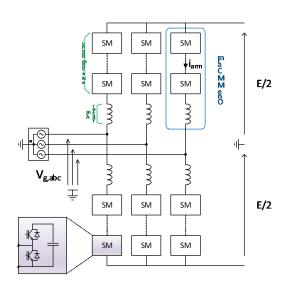
### **TRL SCALE**



Solution tested successfully by simulation on a 350-submodule-par-arm-MMC with Matlab/ Simulink

## **DELIVERABLES**

Know how (algorithm, report, Simulink project)



SuperGrid Institute Shaping power transmission

### **TECHNOLOGY DESCRIPTION**

For Metallized Film Capacitor, most of the degradations happening inside the capacitor cause a loss of the capacitance value. So monitoring this quantity gives a direct estimation of the health of the capacitor. A state of the art of academic studies showed that many solutions were proposed to estimate the value of the capacitor in the MMC application. Some requires additional sensors that are not present actually in the submodule ; some other are able to estimate the capacitor only at power up or power down of the converter, i.e. every 2 years... To overcome this limitation, a method that temporarily by-passes each submodule to observe the discharge of the capacitor in the bleeding resistors has been proposed but this method is quite intrusive in the control of the converter.

SuperGrid Institute has developed a method (know-how) to estimate the value of the capacitor, and by the way its condition, that can be implemented real-time or off-line, that doesn't require any additional sensors