Modular Multilevel Converter Double Star topology AC/DC and DC/AC modeling and study for industrial application

Context :

Power Conversion – a GE Vernova business – has developed Direct Feed, an advanced solution directly connected to the grid to help steel producers optimize their production, while delivering ultimate grid power quality.

Steel production is a CO_2 and energy-intensive activity, which represents 7% of the global energy sector CO_2 emissions. While global demand for steel is projected to increase by more than a third through to 2050, steel producers are committed to reducing the impact of their operations. There are several ways, relying on new technologies, to decarbonize the steel industry and more and more producers are considering transitioning from conventional steelmaking to Direct Reduced Iron (DRI) associated with arc furnace process, which generates 35–40% lower GHG emissions.

The global installed base of Electrical Arc Furnaces (EAF) is expected to expand by three in the coming decades to meet the steel production processes shift. More plants and higher power demands are causing an increased stress on the grid, which stability is already at risk with the rising use of renewable energies. Consequently, grid operators are imposing higher power quality constraints to industrial companies, which must drastically reduce the electrical pollution like flicker or harmonics rejection. Traditional compensation solutions like Static VAr Compensator (SVC) or Dynamic Static VAR Compensators (DSVC) or MMC Delta Statcom previously selected to match required power quality performance will not be sufficient in the future, even less for extra-large furnaces.

GE Vernova's Power Conversion business has developed Direct Feed, an advanced power supply solution, to address this growing challenge. Directly connected to the grid, it allows precise management of the furnace electrode current. The digital control system enables a qualitative monitoring of the electrical arc and prevent disturbances. With the Direct Feed converter system, based on Power Conversion's Modular Multilevel technology, GE Vernova offers an integrated solution ranging from the converter itself to the EAF control and regulations systems, offering improved process performance, reduced maintenance and enhanced grid performance.

Major steel companies have already selected Power Conversion's Direct Feed system to support delivery of their decarbonization program objectives to achieve greater operational efficiencies and cost reductions.

Objectives

The objective of the study is to perform literature review of MMC Double star control, Arc Furnace modeling to understand the structure and control of direct feed solution. Becoming familiar with such architecture will permit to use real time simulation for optimizing the control of MMC based direct feed solution. Optimization are expected in various aspects such as the power delivery, power quality harmonics and flicker, MMC losses….

Work steps

- Bibliography on the subject
- Becoming familiar with the real time simulation of the system
- Propose some change in the MMC control under the support of the team
- Implement and validate those changes in simulation
- Documenting the change and the evaluation in improvement given by the new implementation

Trainee profil

- Profil with Bac+4 or Bac+5 (equivalent to master 1 degree)
- Degree focus in energy conversion, power electronics, electrotechnical and control implementation
- Interest in electrical conversion architecture, real time simulation…
- Knowledge in electrical modeling in non real time tools such as Matlab or in real time tools.

Additionnal information

Duration of internship period : around 6 month

Location: GE Power Conversion Belfort, 24 Avenue du Maréchal Juin, 90000 BELFORT

Contact in the company : Pierre-Louis GARMIER pierre-louis.garmier@ge.com