Architecture of the Future Low-Carbon, Resilient, Electrical Power System

Future Architecture of the Network (FAN) – Te Whatunga Hiko

Workstream 2 –Summer Project

Project title: Development of an Experimental Testbed for Studies on Protection and Fault Location of Hybrid AC/DC Grids

Relevant Workstream(s): WS 2
This project is focussed on Workstream 2

Workstream 2, the development of hybrid AC/DC network topologies and converter configurations for efficient and reliable transport of electricity.

Project Description

The rapid growth in new energy resources and diverse load types has led to increased utilization of DC power in electrical grids. While a complete transition to DC is a future goal, the use of a hybrid AC/DC grid is a more practical solution, applicable across various voltage levels from transmission to distribution and household networks. Ensuring the reliable operation of hybrid AC/DC grids requires a focus on protection and fault location, which are critical areas of study.

The objective of this project is to develop a hybrid DC/AC Experimental Testbed specifically designed for characterizing, verifying, and validating new technologies related to protection and fault location in hybrid AC/DC grids. Existing studies in this field have predominantly relied on simulations or PHIL/CHIL technologies for validation. Therefore, this project aims to establish an Experimental Testbed that allows for practical characterization and validation of protection and fault location technologies in hybrid AC/DC grids. The Experimental Testbed may include a Multiterminal DC system interconnected within an AC grid, or a Point-to-Point DC system interfaced with two AC grids. It is flexible in terms of voltage levels, accommodating studies at medium voltage (MV) or low voltage (LV) levels.

This project requires the involvement of at least two students, each with specific responsibilities:

Student 1:

- Formulate MTDC (Multiterminal DC) or P2P (Point-to-Point) DC links using the VSC converters as part of the existing Experimental Testbed.
- Conduct a comprehensive study on the configuration and implementation of these VSC (Voltage Source Converter) converters and their DSP controllers in the high-risk lab at the University of Auckland.

Student 2:

- Collaborate with Student 1 to work on VSC control, as well as other components of the Experimental Testbed such as AC sources, transformers, conductors, filters, and load banks.
- Document the specifications and configurations of the Experimental Testbed, ensuring comprehensive documentation of all aspects.

Experimental Testbed Formation and Validation:

Upon completion of their individual tasks, both students will collaborate to form the Experimental Testbed. The Experimental Testbed will then undergo validation through several test cases and verified with results obtained from real-time simulations in OPAL RT OP5700.

Specific requirements:

- BE(Hons) - Electrical and Electronic Engineering (EEE) student- Third (second Pro) or Fourth (Third Pro) year.
- Good knowledge of power system grids and power electronics
- Enthusiastic applicants (any nationality) that want to make a positive impact in the world and can work in a collaborative environment

Resources:

High power equipment in high-risk lab at the University of Auckland
PhD thesis: https://researchspace.auckland.ac.nz/handle/2292/61901
Journal paper: Fault Location Estimation in Voltage-Source-Converter-Based DC System: The - Location | IEEE Journals & Magazine | IEEE Xplore

Potential Supervisor(s):

- Nirmal Nair
- Abhisek Ukil
- Saad Khan
- Yuan Liu

Based in: The University of Auckland