Wind Power Modeling & Simulation Using PSCAD

Manitoba Hydro International (MHI) offers multiple training programs to enhance the understanding of PSCAD™/EMTDC™ for practical purposes through case studies and interactive hands-on workshops.

Course Description

This three day course covers the fundamentals of wind power and its integration into the electric grid. Electromagnetic transient program based simulation plays a vital role in a wide range of wind integration aspects. These are highlighted and discussed in the classroom. Several case studies are analyzed in detail to highlight practical situations encountered by engineers in the field. Course attendees are able to experiment with case studies in an interactive hands-on workshop environment using PSCAD simulation software.

Who should attend?

This course is intended for practicing engineers, graduate students, and researchers in power systems, micro grid, and power electronics, who are interested in developing an in depth understanding of the modern tools available for the analysis of transient events in the network. The course is intended for existing PSCAD users as well as introductory users.

Course Methodology

The training will be conducted using a presentation format by the instructor with interactions (questions and answers) with course attendees. The presentations will be followed by hands-on tutorials where the participants will develop practical cases to further reinforce the concepts presented. The detailed course materials and the example cases used in the tutorials portion will be provided for future follow-up and study.

Course Topics

1. Introduction and overview of wind energy and simulation requirements:

- Historical developments
- Modern technology - general overview
- Penetration of wind power in recent past and today's challenges

2. Nature of wind:

- Intermittent nature and wind speed fluctuations
- HVDC terminology, equipment and configurations
- Modelling aspects (gusts, ramps and noise)
- Impact on the system

  Tutorial: Simple grid example and the effect of variable wind

3. Wind turbine characteristics:

- Aerodynamic efficiency

A variety of power systems, PSCAD, and custom training courses are offered by MHI. Training programs offered will assist all clients in fulfilling their learning objectives, whether attendees are beginners or experts.

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- Power curves
- Turbine control options (pitch control, stall control)

  Tutorial: Initialization and power control of a wind generator connected to the grid.

Demonstration: Discussion of a simple MathCAD illustration of turbine characteristics.

4. Wind generators and technology:

- Fixed speed induction generators with stall or pitch control
- Doubly fed induction generator
- Synchronous generator or permanent magnet technology with back to back converters

  Tutorial: Back to back converter based example

5. Doubly fed induction machine concept:

An overview of induction machine theory and a discussion of induction machine characteristics:

- Attraction of variable speed induction machines
- Fundamental concepts of a DFIG

Control of a DFIG for optimum performance with regardto grid requirements:

- Maximum power tracking
- Crow bar protection
- Reactive power control

  Tutorial: Modeling a simplified DFIG controller

Demonstration: Discussion of a detailed DFIG model in PSCAD and identify key features

6. A discussion about wind interconnection requirements at transmission and distribution levels

  Tutorial: Simulation of a wind and diesel based generation connected to the distribution grid

7. Low voltage ride through (LVRT) of wind generators:

- Grid codes and utility requirements

LVRT performance of different generator technologies:

- Induction
- Synchronous
- DFIG

Tutorial: LVRT performance of different generator technology

8. Power quality issues and mitigation techniques:

- Wind turbine start-up transients (voltage dips)
- Flickers (rotational sampling, wind shear)
- Harmonics
- Others

  Tutorial: illustrative example of power quality in WG operation

  Tutorial: Start-up transients including voltage dips.

9. Applications of FACTS devices to enhance performance

  Tutorial: Application of FACTS devices to improve power quality

10. A discussion on mechanical resonance issues of the wind turbine shaft - gearbox

11. Protection issues:

- Islanding issues in distributed generation
- General protection schemes

Course Particulars

Instructor

Course instruction will be provided by one of our many simulation and application experts from the team of PSCAD Support Engineers. CV's available upon request.

Classroom Size

By striving to keep classroom sizes small, there is ample opportunity for questions and discussions among the students and the instructor.

Training Location

Courses can be provided at MHI's Winnipeg location, or an instructor can provide training at client's desired location.

A minimum enrolment is required. Students will be notified two weeks prior to commencement if the course is cancelled.

Manitoba Hydro International Ltd. is a world leader in power system simulation innovation and applied engineering solutions. As the developers of the world-renowned PSCAD™/EMTDC ™ software, we recognize the importance of collaborative partnerships and technologies in the global power industry.

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