SHORT COURSE OUTLINE

GRID INTEGRATION AND GPS STUDIES
OF RENEWABLES IN PSCAD

27 September - Friday 1 October 2021

Follow this link to register your attendance
COURSE DETAILS

BRIEF OVERVIEW OF THE COURSE

COURSE DATE & DURATION
27 September - Friday 1 October
Duration is 5 days inclusive.

COURSE LOCATION
Online.

FURTHER INFORMATION
Visit the registration page here.
ABOUT BEHROOZ...

Dr Behrooz Bahrani received his Ph.D. degree from the Ecole Polytechnique Federale de Lausanne (EPFL), Lausanne, Switzerland, in electrical engineering in 2012. Currently, he is a senior lecturer at Monash University, where he is also the director of the Grid Innovation Hub. Moreover, he is currently a visiting academic at the Australian Energy Market Operator (AEMO). Prior to joining Monash University, he was a postdoctoral fellow at several international universities including EPFL, Georgia Tech (USA), Purdue University (USA), and the Technical University of Munich (Germany). His research interests include control of power electronics systems, applications of power electronics in power systems, and grid integration of renewable energy resources. For his efforts in teaching at Monash University, he received the Dean’s Award for Teaching Excellence and the Dean’s Award for Technological Innovation in Learning and Teaching in 2017 and 2018, respectively.
ABOUT TONY...
Dr Tony Morton gained his PhD from the University of Melbourne in 2000 and has over 20 years’ experience in the modelling and analysis of power systems in industry and academia. His areas of expertise include power system modelling, plant dynamic model and simulation software, power quality assessment and mitigation, embedded generation, demand management, power electronics and renewable energy. Dr Morton is an Expert Assessor for the Australian Research Council, Associate Editor of the journal Control Engineering Practice, reviewer for the IEEE Transactions on Power Delivery, and an Adjunct Associate Professor at Monash University. At Vysus Group Dr Morton coordinates technical capability in Power Engineering and leads delivery of technical assistance across all aspects of electrical plant and grid connection design and performance. Vysus clients include a majority of the top 10 global wind, solar and storage equipment manufacturers, and leading generators in Australia and worldwide.
DAY TO DAY BREAKDOWN
OVERVIEW

OUTLINE OF THE DAY

Day 1 shall be split approximately evenly between “lecture-style” theory sessions and then practical application sessions. The theory sessions shall be in the first half of the day and the practical sessions in the latter half.

The content on Day 1 begins from the fundamentals of the voltage source converter (VSC) and introduces in detail all of the components required for the grid connected control of the VSC. Application sessions shall build on theoretical concepts introduced in the lectures. See below for an overview of what the sessions shall contain.
# DAY 1

## SESSIONAL BREAKDOWN

### DAY 1 THEORY SESSIONS

- Theory on voltage source converter (VSC) fundamentals
- Additional theory on VSCs, building on the fundamentals from and progressing through to grid-connected control techniques.

### DAY 1 PSCAD PRACTICAL APPLICATION SESSIONS

- Building and investigating fundamental components of a VSC in PSCAD
- Investigating the inside of a PLL to motivate the DQ currents control
- Modelling and controlling a grid-connected VSC using both DQ currents control and active and reactive power (PQ) control techniques
DAY 2
OVERVIEW

OUTLINE OF THE DAY
Similar to Day 1, the second day shall be also be split approximately evenly between “lecture-style” theory sessions and then practical PSCAD application sessions. The theory sessions shall be in the first half of the day and the practical sessions in the latter half.

The content on Day 2 builds on concepts presented in Day 1, to include lecture sessions explaining further applications of VSCs and additional grid-following (GFL) control techniques. It will then progress on to presenting grid-forming (GFM) inverters and associated control techniques.

The application sessions will feature various types of VSC topologies with a range of PSCAD exercises on both GFL and GFM models.
DAY 2
SESSIONAL BREAKDOWN

DAY 2 THEORY SESSIONS

• Additional theory on VSC applications, and various external control loop implementations
• Theory on the control techniques of grid-forming (GFM) inverters including droop control and virtual synchronous generator control.

DAY 2 PSCAD PRACTICAL APPLICATION SESSIONS

• Building further external control loops in PSCAD, incl. DC Link voltage control, terminal voltage control, reactive power control
• Building a STATCOM model in PSCAD and investigating its functionality
• Modeling and investigating motivations for a Type 4 (dual inverter) topology
• GFM inverter control techniques will also be presented
OVERVIEW OF DAY 3 FOCUS

Day 3 introduces Tony Morton from Vysus group who is also an Adjunct Professor at Monash University, where the course direction is turned towards Generator Performance Standards (GPS) aspects. After some context and an introduction to GPS studies, the day shall progress towards sequentially introducing clauses within the National Electricity Rules (NER) as highlighted within the PSCAD Study section of the AEMO connection application checklist.

There will be four NER clauses introduced and investigated in Day 3, where for each clause it will be introduced in a lecture style session and then investigated in a practical session, with a cumulative wrap-up at the end of the day.
### DAY 3

#### SESSIONAL BREAKDOWN

#### DAY 3 THEORY SESSIONS

- Introduction and context for GPS studies and the NER
- Sequentially introducing the following clauses concerning GPS studies found within Schedule 5.2 of the NER:
  - S5.2.5.13 - Voltage and reactive power control
  - S5.2.5.14 - Active power control
  - S5.2.5.3 - Generating system response to frequency disturbances
  - S5.2.5.4 - Generating system response to voltage disturbances

#### DAY 3 PSCAD PRACTICAL APPLICATION SESSIONS

- The practical sessions will involve using setting up the GPS tests within PSCAD case files and then monitoring the results from the perspective of the respective clauses as above.
OVERVIEW

OVERVIEW OF DAY 4 FOCUS

Day 4 continues with Tony Morton from Vysus group, where the day shall follow along with the remaining four clauses found within the PSCAD study section of the AEMO Connection Application Checklist.

Day four will adopt the same process of introducing a clause in a lecture style session and then directly investigating that clauses in an application session.

It is also noted that the investigations for clause S5.2.5.12 is more of an exploratory open-ended case study.
DAY 4
SESSIONAL BREAKDOWN

DAY 4 THEORY SESSIONS

- Recap of the previous day
- Sequentially introducing the following clauses concerning GPS studies found within Schedule 5.2 of the NER:
  - S5.2.5.5 - Generating system response to disturbances following contingency events
  - S5.2.5.8 - Protection of generating systems
  - S5.2.5.11 - Frequency control
  - S5.2.5.12 - Impact on network capability

DAY 4 PSCAD PRACTICAL APPLICATION SESSIONS

- Similar to Day 3, the practical sessions will involve using setting up the GPS tests within PSCAD case files and then monitoring the results from the perspective of the respective clauses as above.
OVERVIEW

OVERVIEW OF DAY 5 FOCUS

The final day, Day 5, will be a combination of the lecture/application session mix and shall introduce our various invited industry speakers.

The first part of the day shall feature presentation and lecture with Tony Morton from Vysus group presents a DMAT guideline for the grid integration of renewables. The day will then lead into a round table discussion providing the opportunity to discuss and answer questions from participants. The final afternoon session will focus on implementation of some DMAT tests on a PSCAD case study.
DAY 5
SESSIONAL BREAKDOWN

DAY 5 PRESENTATIONS

• Introduction and context for DMAT guideline studies.
• The speakers form industries for an interactive round table session.

DAY 5 PSCAD PRACTICAL APPLICATION SESSIONS

• DMAT tests case study in PSCAD following from the presentation on DMAT.
FOR FURTHER INFORMATION

POINTS OF CONTACT

ANY FURTHER ENQUIRIES
If you have any further questions please contact Dr Behrooz Bahrani at behrooz.bahrani@monash.edu.

Please note that we also have a list of FAQs on the registration website that may already answer any questions you might have, which again can be found here.