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Industry relevant teaching - a case study

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ABSTRACT: Engineering graduates start their career with strong theoretical background, but often lack skills to implement the learned knowledge in practice. However, industry prefers work-ready graduates with both good theoretical knowledge, but also ability to use this knowledge to solve practical problems. A recent project sponsored by the Australian Government, opened up an opportunity for the establishment of a link between the University of South Australia (UniSA), Adelaide, Australia, and an industry partner, to develop an industry-relevant project for one of the electrical power systems courses. In this article, the project and experiences in teaching the third year electrical engineering students in using the courseware developed in collaboration with the industry partner company PSD Energy are described and discussed.

Keywords: Electrical power, engineering education, protection design, industry based project

INTRODUCTION

The modern engineering industry competes in a global market. Thus, increasing productivity is an important factor in every aspect of company operations. One of the important aspects in this task is employment of work-ready workforce. This is becoming an increasing issue for engineering graduates starting their career in the electrical power industry. A decrease in a number of students interested in studying engineering and a reduction in government funding over recent decades has left universities with dated teaching facilities, particularly resources that require significant investment, such as engineering laboratories. The situation is most visible in disciplines like electrical power engineering where the equipment is expensive and requires continuous maintenance and upgrade.

Teaching electrical power engineering courses is, therefore, often limited to teaching the theory without much hands-on practical work in an electrical engineering laboratory. This approach also reduces students' motivation and affects the quality of their learning as they fail to establish a link between the theory and the relevant practice.

Numerous pieces of research in engineering education point to a disconnection between industry requirements and university curricula on one hand, and the importance and benefits of partnership between industry and universities in structuring, evaluation and delivery of engineering programmes on the other [1-11].

To address these issues at least partially, and to increase student learning outcomes, in association with an industry partner company (PSD Energy), a project has been developed for the 3rd year course Power Systems Analysis, which is described in the following sections.

INDUSTRY BASED PROJECT

The project was developed as a semester long exercise for students enrolled in the fundamental electrical power engineering course. The project was named the *Iron Knob* project and is based on one of the projects recently completed by the industry partner company PSD Energy based in Adelaide, Australia. Permission to use all specification data related to the project was obtained from the client. This can be considered to have been the most valuable part of the project. It gives the whole exercise a dimension of reality as students work on real industry project using real data, modelling a real system and using industry standard software and hardware.

The project has been developed to include several stages that will guide students to a design of a protection for a power system of a reasonable size. This includes:

1. System modelling;
2. Power flow simulation;
3. Fault analysis;
4. Protection design;
5. Setting real hardware (distance relay) for protection;
6. Testing the distance relay using testing facility of the industry partner company.

In stages 1-4, students will use professional, industry standard software. In stage 5, students learn to use and set up an industry standard hardware. In stage 6, students visit the industry partner company to participate in the testing procedure of the protection relay.

SOFTWARE DESCRIPTION

The software purchased, specifically for this project, is DIgSILENT Power Factory version 15 [12]. This software was recommended by the industry partner as PSD Energy used this software for this project as for many other projects completed by the company. Fortunately, the educational version of the software is available at a very affordable cost.

The software has a user friendly Graphical User Interface (GUI) shown in Figure 1, with a range of symbols for power systems components on the right-hand side panel. This makes it easy for users to configure an electrical power system by simply drawing the single-line diagram of the system and enter parameters for all components required by the software for different types of simulation/calculation.

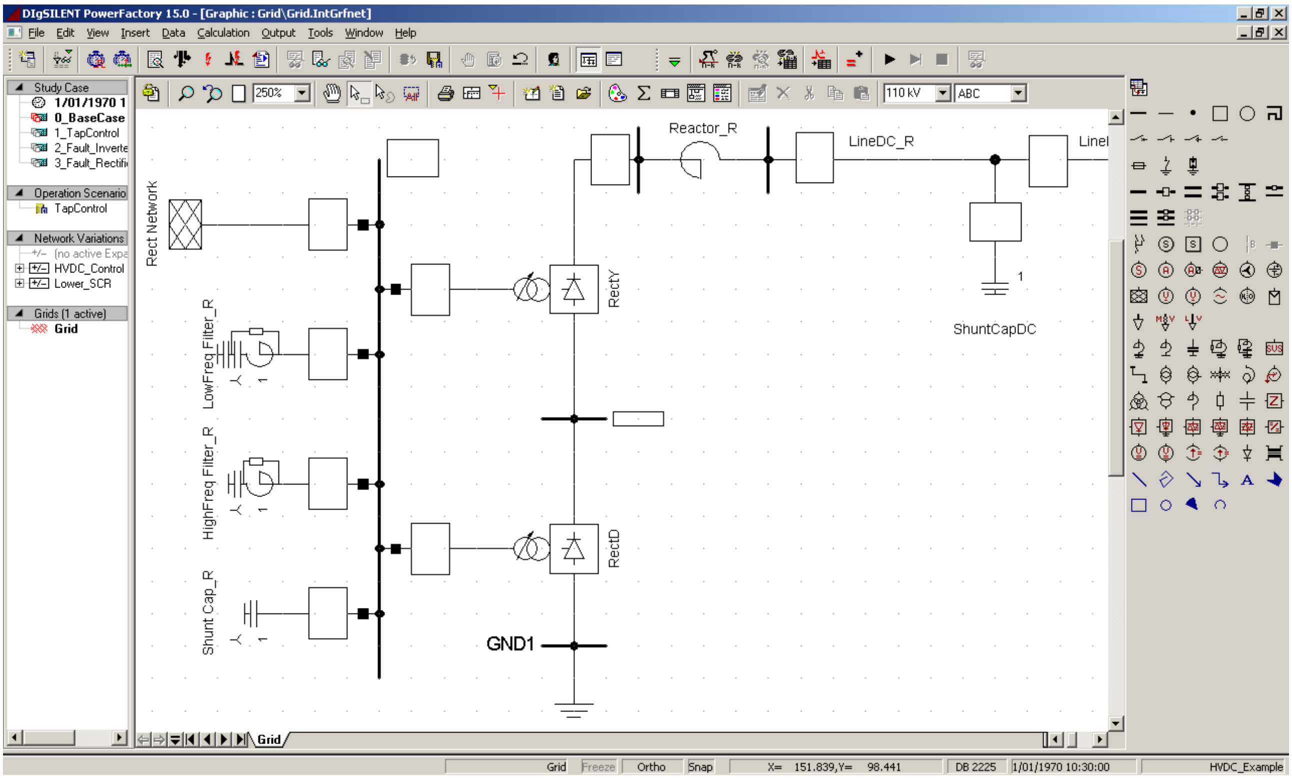

Figure 1: DigSILENT PowerFactory GUI showing application example of a HVDC system [13].

The software guides the user through the system configuration and, unlike other software used in teaching electrical power systems courses, does not require any programming skills [14]. Through the use of the software, students reinforce the theory learned in the course and also see the relevance of the theory in practical applications. A template for a DC transmission line is shown in Figure 2. It can be seen that several parameters need to be entered. The template uses the professional jargon, e.g. *positive sequence impedance*; *zero sequence resistance*, *distributed parameter line model*, etc.

These are abstract concepts for students, which they often try to avoid learning assuming this is just more mathematics they will never use in practice. This simple example of the use of industry standard software proves to students that they have to learn these new concepts if they intend to work in the power industry. The software can also inspire them to learn more as browsing through power system configuration templates exposes students to a lot of terms and concepts that are beyond the scope of university courses. Once students are motivated, the lecturers' teaching task becomes much easier.

The software is comprehensive and can be used for system analysis and design like, power flow analysis, fault analysis, contingency analysis, power quality and protection system design, just to mention a few. The software also supports modelling and simulation of modern power systems that include distributed generation, wind turbines, solar PV-panels, micro turbines, battery storage and other components of smart grid, as well as various power electronic devices. In total, PowerFactory software supports 500 different objects that can be used for modelling power systems.

The software has a capability to exchange data with other professional software for power systems analysis like Power System Simulator for Engineers (PSS/E) [15], as well as with Supervisory Control and Data Acquisition (SCADA) systems.

In undergraduate courses, only a fraction of the software capabilities will be used. However, it can be a useful tool in designing the curricula of these courses. The courses can be structured around the exercises using the software, rather than trying to fit the software exercises around the power engineering theory covered by conventional curriculum.

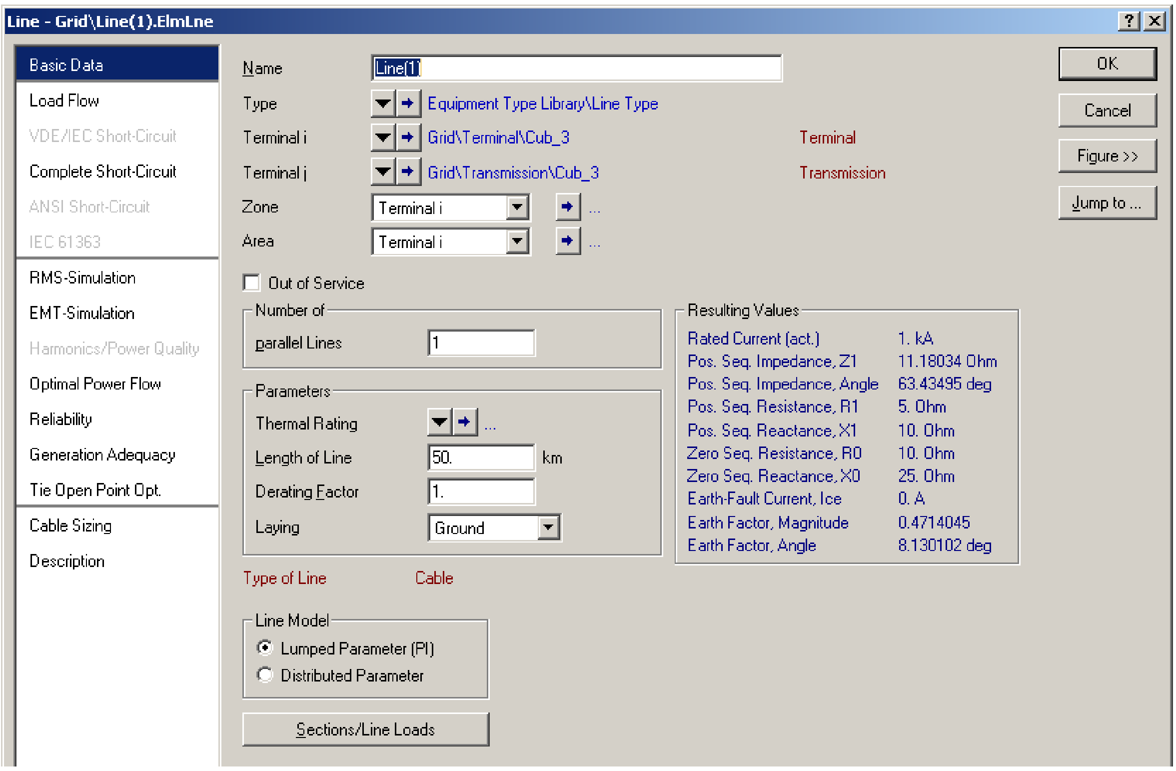

Figure 2: DigSILENT PowerFactory template for DC transmission line basic data parameters [13].

HARDWARE DESCRIPTION

Hardware was also selected on the recommendation of the industry partner company. For the purposes of the project, the Transmission Protection System SEL-311C shown in Figure 3 was purchased [16]. The hardware is actually a relay for protection, reclosing, monitoring and control of transmission lines. It is a modern electronic device that includes software for its configuration and provides an option for on-line setup. It also includes various data communication options suitable for interfacing into a SCADA system.

Figure 3: SEL-311C transmission protection system [16].

IMPLEMENTATION OF THE PROJECT

The project is still in its developmental stage and is planned to be fully implemented during 2014. However, for the benefit of 2013 students, stages 1-3 have already been implemented. This allowed students to grasp the fundamentals of industry standard software and take the full benefits of using it as described in the previous sections. To make the project more industry relevant, two engineers from the partner company have been invited to give a talk on the project, as well as present their experiences as graduate engineers working in power industry.

Although a proper survey will be run next year to evaluate the project, students' feedback this year was very positive. The students responded well to the introduction of the project and appreciated learning the professional software. They also highly appreciated interaction with young engineers from the partner company.

CONCLUSIONS

Although all stakeholders agree that collaboration between industry and universities is important and beneficial to students, industry and universities, there is no framework that successfully supports this alliance. Evidently, there is a number of reasons that hinder the solution of this problem, which exist on both sides of the fence; namely, in industry as well as at university. If this is to be resolved in a near future for the benefit of society, the source of a resolution of the problem must come from an external entity, most probably the government.

In this article, a case study has been presented of a course practical component developed in a collaboration between UniSA and an industry partner (PSD Energy). The project aims to enrich students' learning experience by engaging them in an industry relevant project. Although this represents a small step towards achieving the stated aims, it is a good example of how even limited resources can make a big difference in students' motivation and learning outcomes.

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