

# 2 PhD positions in “Power system protection and control in digital substations (ProDig)”

## About the position

The Department of Electric Power Engineering has vacancies for two 100% PhD positions within “Power system protection and control in digital substations (ProDig).”

The described positions are part of a new Norwegian Research Council KPN-project ProDig, consisting of nine industry/utility partners, within the ENERGIX program. ProDig is multi-disciplinary, multi-vendor, PhD-incentive and international. (In addition to the 2 PhD positions announced here, the ProDig project will also include one PhD at the Dept. of Information Security and Communication Technology, NTNU, and another at the Dept. of Electrical and Computer Engineering at Michigan Technological University.)

The PhD candidates will be members of the High Voltage Technology (HVT) research group at the Department of Electric Power Engineering, <https://www.ntnu.edu/iel/groups/hvt#/view/about>.

The PhD candidates will work under the supervision of Professor Hans Kristian Høidalen, <https://www.ntnu.edu/employees/hans.hoidalen>.

The position reports to the Head of department.

## Main duties and responsibilities

Substations are critical nodes in the power system and consist of lines, transformers, generators, compensation equipment, switchgear and instrument transformers. In a substation, the power system is controlled and protected. The term digital substation describes a technology where classical copper wiring between instrument transformers, switchgear, protective relays and control equipment is replaced by process bus and Ethernet cables. The main advantages are smaller footprint (reduced wiring, and buildings), easier expansions (plug&play), simpler documentation and engineering and possible faster future upgrade. The challenges are related to the fact that this is new, unproven technology. Test pilots of digital substations are now being installed world-wide.

Modern intelligent electrical devices (IED) like protective relays can now communicate on process and station buses in a digital substation environment. Information from all instrument transformers and protective relays is available to all connected devices. This opens new possibilities, but it also poses a threat to security and reliability, with new devices exposed to substation stress. What is sure is that this digital shift will require new knowledge and competence in both communication and power system behavior.

### PhD1: Strategies for protection and fault location in digital substations

This PhD project aims at utilizing a digital substation and wide-area environment (providing more real-time information and observability due to more sensors) to improve protection and fault location schemes, particularly in complex, multiple-fault cases. The topics of interest are:

- Detection and location of ground-faults in isolated or resonance grounded systems.
- Fault location using distributed sensors and wide-area strategies
- Protection and fault handling in complex fault situations, with possibly multiple faults
- Utilization of the increased system observability for adaptivity of protection settings
- Communication, self-healing, transient based protection

### PhD2: Sensor technologies for digital substations

This PhD project is related to usage of non-conventional instrument transformers and sensors in digital substations. This is primarily optical current transformers with their merging units and fault indicators. A special concern is the interoperability of existing technology and new sensors in differential protection schemes. Testing and qualification of non-conventional sensors in NTNU high current lab will be made. The topics of interest are:

- Non-conventional instrument transformer performance
- Merging units, synchro-phasors, sampled values precision and accuracy
- Multi-vendor applications, interoperability
- Application in relay protection
- Wide-area disturbance identification

The Department of Electric Power Engineering has an advanced laboratory with digital substation capabilities. This includes real-time simulators and relay testers with IEC 61850 capabilities, modern relays and merging units connected to process bus, and high-power labs for actual performance testing. The ProDig project follows up the ProSmart project <https://www.ntnu.edu/prosmart>.

## Qualification requirements

The qualification requirement is completion of a Master's degree with strong academic background with a grade of B or better in terms of NTNU's grading scale. Applicants must hold a Master's degree or equivalent in electrical engineering with good knowledge of power systems and relay protection.

The appointment is to be made in accordance with the regulations in force concerning State Employees and Civil Servants Civil Servants, and national guidelines for appointment to PhD, postdoctor and research assistant positions.

NTNU is committed to following evaluation criteria for research quality according to [The San Francisco Declaration on Research Assessment - DORA](#).

#### **Other qualifications:**

Applicants must have very good English language skills, written and spoken. Applicants from non-English speaking countries outside EU/EEA/Switzerland must provide preliminary documentation of English language proficiency, in terms of an approved test. The following tests can be used: TOEFL, IELTS and Cambridge Certificate in Advanced English (CAE) or Cambridge Certificate of Proficiency in English.

Further assessment of both written and oral English language skills and the ability to communicate fluently may be conducted in the continued selection process and during any interview for all applicants, including those providing the required documentation of English proficiency.

## **Personal characteristics**

In the evaluation of the candidates, emphasis will be placed on education, experience and personal suitability, as well as personal motivation for the position, in terms of the qualification requirements specified above.

## **We offer**

- exciting and stimulating tasks in a strong international academic environment
- an open and [inclusive work environment](#) with dedicated colleagues
- favourable terms in the [Norwegian Public Service Pension Fund](#)

## **Salary and conditions**

PhD candidates are remunerated in code 1017, and are normally remunerated at gross from NOK 479 600 per annum. From the salary, 2% is deducted as a contribution to the Norwegian Public Service Pension Fund.

The employment contract is for three years; however, there is a possibility for extension up to four years if selected for assistantship.

Appointment to a PhD position requires admission to the PhD programme in Electric Power Engineering. Applicants must be qualified for admission as PhD candidates at NTNU. See <https://www.ntnu.edu/ie/research/phd> for information about PhD studies at NTNU.

As a PhD candidate, you will have to successfully complete the PhD academic training programme; the training includes mandatory course work and other obligatory activities. Within the first three months of your employment, you must formally qualify for admission to the PhD programme at the Faculty of Information Technology and Electrical Engineering.

## **General information**

A good work environment is characterized by diversity. We encourage qualified candidates to apply, regardless of their gender, functional capacity or cultural background. Under the Freedom of Information Act (Offentleglova), information about the applicant may be made public even if the applicant has requested not to have their name entered on the list of applicants.

Questions about the position can be directed to Professor Hans Kristian Høidalen, [hans.hoidalen@ntnu.no](mailto:hans.hoidalen@ntnu.no) or to Head of Department Prof. Ole-Morten Midtgård [ole-morten.midtgard@ntnu.no](mailto:ole-morten.midtgard@ntnu.no).

#### **About the application:**

Applications are to be submitted electronically through this page (<http://www.jobbnorge.no>).

The application must contain:

- A cover letter where the applicant describes his/her personal motivation and how he/she intends to fill the position.
- Curriculum vitae (CV) which includes information about the candidate's prior education, work experience, academic merits and any scientific publications.
- Certified copies of academic diplomas and certificates.
- Applicants from universities outside Norway are kindly requested to send a diploma supplement or a similar document, which describes in detail the study programme and grading system.
- Names and contact information of at least two references.

Incomplete applications will not be taken into consideration.

The engagement is to be made in accordance with the regulations in force concerning State Employees and Civil Servants, and the acts relating to Control of the Export of Strategic Goods, Services and Technology. Candidates who by assessment of the application and attachment are seen to conflict with the criteria in the latter law will be prohibited from recruitment to NTNU.

The Department of Electric Power Engineering works closely with key players in the Norwegian electricity supply sector, who manage critical infrastructure. A comprehensive risk assessment of the candidates' research interests and potential activities related to national threat assessments will therefore also form basis for the final selection of candidates.

In the final assessment of the candidates, strategic considerations at the Department of Electric Power Engineering will also be taken into account.

Application deadline: September 15, 2019

## NTNU - knowledge for a better world

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The Norwegian University of Science and Technology (NTNU) creates knowledge for a better world and solutions that can change everyday life.

### Department of Electric Power Engineering

Our department is Norway's leading in the field, and our vision is to be at the centre of the digital, green shift. We have excellent collaboration with business and industry as well as other universities and research organizations internationally. This gives us outstanding opportunities for interdisciplinary research with high relevance for the society, addressing industrial needs and global challenges. The [Department of Electric Power Engineering](#) is one of the seven departments at the [Faculty of Information Technology and Electrical Engineering](#).

Jobbnorge-ID: 173084, Søknadsfrist: Søknadsfristen er gått ut