



**Graduation assignments
offered by
DNV KEMA Energy & Sustainability**



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1 **DNV KEMA ENERGY & SUSTAINABILITY – WE'VE GOT THE POWER**

1.1 **Introduction**

KEMA is an international and commercial company, founded in 1927, that is closely involved in the future of the way power is supplied and electricity is used around the world.

As of 29 February 2012 DNV and KEMA create a world-leading consulting and testing & certification company for the global energy sector.

This new company is called DNV KEMA Energy & Sustainability (DNV KEMA).

DNV KEMA Energy & Sustainability, with more than 2,300 experts in over 30 countries around the world, is committed to driving the global transition toward a safe, reliable, efficient, and clean energy future. With a heritage of nearly 150 years, we specialize in providing world-class, innovative solutions in the fields of business and technical consultancy, testing, inspections & certification, risk management, and verification. As an objective and impartial knowledge-based company, we advise and support organizations along the energy value chain: producers, suppliers & end-users of energy, equipment manufacturers, as well as government bodies, corporations and non-governmental organizations. DNV KEMA Energy & Sustainability is part of DNV, a global provider of services for managing risk with more than 10,000 employees in over 100 countries.

DNV KEMA is headquartered in Arnhem, the Netherlands, and is now part of the DNV Group.

1.2 What we can offer you

DNV KEMA Energy & Sustainability has 7 Global Business Lines (GBL) which are spread throughout all our 4 regions; NMEA (Netherlands, Middle-East & Africa), Europe, Americas and Asia Pacific. Our head office is located in Arnhem, The Netherlands. In this document we will inform you on possibilities within our several Business Lines:

- Electricity Transmission & Distribution
- Gas Consulting & Services
- Management & Operations Consulting
- Power Generation & Renewables
- Sustainable Use
- Testing, Inspections & Certification
- Transportation Systems

We are always on the lookout for ambitious higher vocational and university-level students in technical fields. DNV KEMA offers graduation internships to students **with a study background in f.e. electrical engineering (energy engineering), (technical) physics, (technical) chemistry, mechanical engineering, sustainable energy technology (and other sustainable studies), information technology and mathematics.**

This document gives you an idea of in which broad subjects DNV KEMA can offer you graduation internships and/or master projects. Please be informed that, in general, we only offer **graduation** assignments.

However, it does not always mean that we do not offer certain graduation subjects which are not mentioned in this document. So we suggest that when you are interested in doing your internship at DNV KEMA, to please send us your resume so that we can consider if a suitable graduation assignment can be defined for you which, naturally, matches to your study background. Please note that suggestions are always welcome!

For specific **graduation assignments**, please visit our website

<http://kema.com/careers/europe/internships.aspx>

Are you looking for a **starting position** after your graduation? For specific information and an overview of all our current vacancies, please visit our website:

www.dnvkema.com/careers.



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In case you are interested in working at DNV KEMA (as intern or starter), please send your resume with motivation letter to Ms Natasja Heussen (Recruiter NMEA):

E: Natasja.Heussen@kema.com

T: +31 (0) 26 356 3870

You can also fill out the form on our website to apply for an open vacancy.

We kindly thank you for your interest and hope to welcome you soon at DNV KEMA Energy & Sustainability!



2 **ELECTRICITY TRANSMISSION & DISTRIBUTION (ETD)**

Business Line ETD offers specialized and innovative services in Electricity Transmission and Distribution to Utilities, Governments and Industry. The consultancy services cover the complete life cycle from strategy and decision making, power systems planning, design and construction of power links and substations to asset management and operations. The main goal is to secure and improve reliability, efficiency, safety, life time and environment-friendliness of technical installations at the lowest possible costs.

2.1 **Asset Management**

Team AM focuses on existing infrastructures and existing equipment. AM supports managers and service providers of high voltage equipment to utilize and maintain their assets by assessment of and consultancy on their assets and the related processes and organization in order to control the risks and optimize the performance within agreed targets.

AM offers internships on the following subjects:

- Health indexing tools (electrical engineering, mathematics, IT)
Developing knowledge rules, algorithms and statistical tools to estimate the equipment health from various data sources.
- Economic impact of equipment health (economy / business)
Integration of economic impact in health index methodology in order to derive an economical equipment health index.
- Transformer lifetime modeling (electrical engineering, mathematics)
Extending existing transformer lifetime model (additional subcomponents and degradation mechanisms e.g. for bushing and tap-changer); development of user interface.
- Switchgear diagnostics survey (electrical engineering)
Investigating the available diagnostic measurement equipment for the assessment of condition and remaining lifetime of high and medium voltage switchgear
- Corrosive sulfur diagnostics (chemistry)
Investigating ways to diagnose the damage caused by the impact of corrosive sulfur.
- Maintenance database (electrical engineering, IT)
Survey of literature and reports from practice on maintenance methods and programs for electrical T&D equipment; designing and building data model and database.

- Power failure database (electrical engineering, IT)
Conceptual design of power failure database; data model and prototype based on available report data.
- Survey of the over voltages that appear in power cable networks, with sources as oscillations and transients from switching or short circuit actions
- Software program to calculate the remaining life of a power cable network, where the input is the historical current load, soil conditions and types of components used.
- Studies of the effect of the current load on the very high mechanical forces that create damage to accessories as power cable joints and terminations
- Studies to help to introduce a withstand current test next to the already existing withstand voltage test. Such tests are needed after the installation of a new power cable system to check for any engineering or installation mistakes. A withstand current test is an interesting new tool and probably possible because of the now available power electronics.
- Studies of the tools that can be used to detect joint and termination locations in power cable networks with on-line pulse reflection methods.
- Studies of the tools that can be used to detect failure locations in power cable networks with on-line pulse reflection methods.
- Studies to learn how a breakdown channel is created in the insulation of a failing object. This can help to identify whether a failure cause is on the outside or the inside of an object.

2.2 Power Links

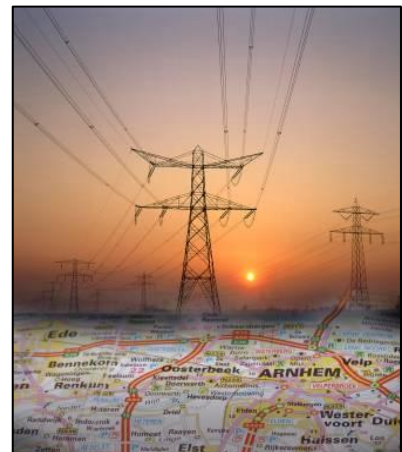
Team POL specializes in high voltage overhead lines, high voltage cables, and EMC (Electromagnetic Compatibility) and offers internships on the following subjects:

HV overhead lines:

- Suggestions on this specific graduation subject are welcome!

HV cables:

- Survey regarding the effects of heating of the soil, because of cable installed. Effects concern organic life in the soil; culture of microbes, effects on vegetation, how to control
- Evaluate the possibilities of application of artificial cooling of underground cables; the generated lost heat is being transported via a system of parallel tubes with running water, for useful use



- Evaluate application of very long cable distances (e.g. 200km); behavior of such long cable (capacity) in an inductive grid, execution of an effective Site Acceptance Test, reducing reliability due to a large number of accessories, diagnostics: how to detect errors, desirable compensation techniques
- Literature research of international/intercontinental submarine cable connections: making an inventory, costs, reliability, maintenance, problems.
- Determination of a new method to determine thermal characteristics of soil surrounding cable connections
- Determination of electromagnetic influence of EHV cable systems and the way this is being calculated by IEC and in EMTP. Which assumptions are the best, in which calculation way?

EMC:

- Magnetic fields from high voltage infrastructure
- Standardizing of typical configurations HV-lines and their influence on pipelines
- Lightning protection of wind turbines

2.3 Strategy & Governance

Team SGO supports TSOs, DNOs and their financial stakeholders with the preparation of their management decisions and policy development by providing insights during the decision process and tackling business uncertainties in order to improve the quality of our client's decisions in terms of transparency, efficiency and rationale.

SGO offers internships on the following subjects:

- Comparing specific and general models for the arrangements of a modern generating unit
- Specify and possibly create a grid simulation game by "modding" an existing computer game, this can be a single user game on a PC but also a multiplayer on-line and can focus on one or more aspects of a Smart Grid like economic efficiency, capacity use and development, availability and stability, integration of renewable energy sources, et cetera.

2.4 Substations Projects

Team SUP supports users and owners with the design, realization and control of their complex electrical installations and constructions by providing impartial high quality consultancy and inspection based on technical excellence in order to find an optimal balance between reliability, performance, costs and safety. Focus offerings are High voltage installations, HVDC & Power electronics, LV services, Civil inspections and supervision.



SUP offers internships on the following subjects:

- Develop the concept of power hardware-in-the-loop (PHIL) for the Flex Power Grid Laboratory at DNV KEMA and realize a pilot version. This will include the use of suitable hardware for simulation interfaces to connect the hardware and software simulation platforms. This will at first be a PC based solution and will be developed further for real time simulator platforms.
- Develop and build a visual demonstration that demonstrates the capability of the Flex Power Grid Lab to (non-technical) visitors.
- Survey of LV and MV DC applications and the possibilities of the FPGL for validation and testing..

2.5 System Design & Analyses

Team SDA advises owners and asset managers on the development and operation of their power systems by technical design and analysis of these systems in order to improve system performance and meet our client's business interests.

SDA offers internships on the following subjects:

- Penetration level RES related to system adequacy
- Penetration level RES related to frequency stability

3 **GAS CONSULTING & SERVICES (GCS)**

Business Line GCS, located in Groningen, consists of 4 teams in which technical and management consultants work along the entire gas value chain. Typical topics are policy and strategy, market research, regulation, asset integrity, safety, smart energy grids, sustainable gases, energy efficiency, gas analyses, flow consultancy and testing.

3.1 **Gas Infrastructure & Transport**

Team GIT has set itself the mission to support gas transmission and distribution companies to transport gas in a safe, reliable and efficient manner. We provide technical knowledge and practical experience in the form of research projects, consultancy or technical services throughout the complete life cycle of a pipeline or installation. We are currently expanding the areas of asset integrity consultancy and are looking for new colleagues for our growing team.

GIT offers internships on the following subjects:

- Set up market and business plan for this team
- Upstream gas conditioning
- Optimization of adaptation to the gas transport system with the aim to supply sustainable energy.

3.2 **Gas Policy & Strategy**

Team GPS combines technical and economic knowledge and is specialized on the advice of clients in questions around policy and/or market developments and related strategic issues, primarily in the gas sector. We are currently expanding the areas of sector-specific strategy and gas policy consultancy and are looking for experienced new colleagues for our growing team.

Team GPS offers internships on the following subjects:

- Sustainability studies
- Market assessments
- Regulatory issues
- Energy Policy studies



3.3 Gas Quality & Flow

The Gas Quality & Flow department focuses on gas quality and gas flow issues. Gas quality issues include pollutant, calorific value of the gas and gas interchangeability of gases from different sources. Gas flow issues include quantity measurements (related to billing), the dynamic behavior of gas flows, gas flow related noise and vibrations and calibration & testing of gas flow meters. Team GQF runs several state of the art laboratories and testing facilities. Team GQF offers internships for ambitious students (higher vocational and academic level) in the area of Chemical technology, Fluid Mechanics, Process technology, Technical Physics

Typical subjects are on:

- Green gas / bio gas infeed
- Water/oil/gas separation technologies
- Development of natural gas flow measurement and testing techniques
- Analyses and development of impurities and pollution in natural gas



3.4 Sustainability & Clean Energy

Team S&CE focuses on new gases (such as biogas and Hydrogen), CO₂ transport (as an integral part of Carbon Capture and Storage), smart grids and gas applications, and energy efficiency and footprint reduction. Innovative technology which links up with the current energy supply and create a bridge over to renewable sources can accelerate the transition towards sustainable energy. The technology of natural gas and gaseous energy carriers is a bridging technology. Against that background we provide advice, perform research, carry out measurement programs and enter into strategic collaboration. Team S&CE offers internships on the above mentioned subjects, including feasibility studies, and modeling and experimental work.

4 **MANAGEMENT & OPERATIONS CONSULTING (MOC)**

Our Business Line MOC focuses on issues that are top of mind for utility executives, policy makers, regulatory authorities, and other key energy industry stakeholders. We offer advisory services for program management, business process redesign, development and implementation of technology roadmaps, and achieving sustainability, policy, and strategic targets. MOC offers business and technical consulting services to governments, regulators, utilities and technology providers. MOC is divided in teams.

4.1 **Intelligent Networks & Communications / Power Systems Operation**

INC targets decision-makers responsible for integrating advanced metering and communications systems, with utility information technologies such as distribution automation systems, utility engineering, and work management systems. INC supports our customers with the transition towards the smart grid. Security is becoming more and more important with the smart grid and Advanced Meter Infrastructure being rolled out.

Team PSO provides expertise in SCADA, EMS, DMS, MMS, GMS, and OMS strategies, procurements, and implementations, as well as in wholesale market strategies and operations.

In this team we offer internships on the following subjects:

- Software Development
- Communication Protocols
- EMS/SCADA/DMS
- Smart Metering
- Smart Grids

4.2 **Operational Excellence / Markets & Regulations**

OPE combines strategic expertise in financial analysis, risk management, organizational transformation, and market analyses with operational experience in delivering solutions architecture and process improvements to assist clients in achieving their mission and goals. OPE serves energy trading and supply companies, distribution- and transmission system operators, governments and regulators.

MAR can advise clients in all economic- and engineering-related issues within the energy markets. Services are provided to all relevant stakeholders worldwide, including policy makers and regulatory institutions, network and system operators, energy exchanges,

generation, trading and supply companies, consumers, and investors. MAR serves utilities, transmission system operators or other infrastructure companies, governmental organizations, regulators as well as investors in energy (electricity and gas) market and regulatory related questions.

In this team we offer internships on the following subjects:

- Smart Metering
- Smart Grids
- Business Process Redesign
- Data Management
- Market Modeling
- Grid Economics
- Regulations
- Tarifications
- Electrical Vehicles



5 POWER GENERATION & RENEWABLES (PGR)

Business Line PGR offers specialized and innovative services to the energy branch, governments, waste processing companies and industry. The main goal is to improve efficiency, reliability, safety and environment-friendliness of technical installations at the lowest possible costs. PGR is divided in the 5 following teams.

5.1 Clean Fossil Power

Team CFP serves utilities and industry all over the world. This team consists of a group of technical professionals and consultants with a wide knowledge and expertise on coal fired and gas fired power stations. The CFP competence center is based in Arnhem, the Netherlands. However, many other CFP consultants reside in and work for our local offices in Germany, the United States, Colombia, Australia, Middle East, Spain, Portugal and the United Kingdom, being supported by the Arnhem office.

As an impartial and trustworthy partner, DNV KEMA is often involved in early stages of a realization or repowering project. On our track record you may find projects as for example:

- Location studies : assisting a client to find the most optimal location for their new asset
- environmental impact assessment : assisting a client to obtain the desired permits and environmental impact assessment
- Feasibility studies: determining the technical and economic feasibility of a new plant (realization project) or of an existing plant that is being refurbished (retrofit or repowering project)
- Operational impact studies: evaluating the operational consequences of the implementation of modifications to installations or processes
- (Technical) due diligence : evaluation of the (technical) value of existing assets in order to support a client to sell or buy an asset
- Thermodynamic performance studies : calculating the thermodynamic performance of an installation (with KEMA SPENCE®) in order to find the optimal process conditions (for example efficiency)
- Conceptual design studies : designing and high-level engineering of installations and processes to create the optimal layout of a (new) installation.
- State-of-the-art reviews and benchmark studies : informing the client on the state-of-the-art of certain technologies and installations, and how each of them performs and benchmarks against other processes

- Third party assessor : acting as an independent assessor of technologies or facilities, that may be subject of a dispute
- Owner's representative: to represent and assist a client in their tendering, acquisition and construction process of a new or refurbished installation.

The issues that are mentioned above can be related to various projects. We have a wide track record on projects in the fields of:

- Biomass co-firing and 100% coal and biomass firing. To replace coal by biomass, in order to reduce the emissions of CO₂
- Flue gas treatment and emission management. To reduce the emissions of e.g. dust, NO_x and SO₂
- Carbon capture. To capture, transport and store CO₂ in geological formations
- Energy efficiency. To improve the efficiency of an installation
- Power plant operational support. To enhance the performance and operation of a plant
- New build facilities. To build new coal, biomass, oil or gas-fired facilities

5.2 New Energy Technology



Team NET focuses on exciting new sorts of renewable energy. These include photovoltaic electric power, concentrated solar thermal power, concentrated photovoltaic power, fuel cells, membranes for gas separation, membranes for water treatment and capture, carbon capture and storage, electric mobility in all sizes and shapes, integration of charging profiles into the electricity grid, more general smart grid applications and much more.

Next to this, and essential for our operations, we have several large and well-equipped labs, including a plastics lab, a dedicated battery lab, an (organic) chemistry lab, and a large experimental hall.

As an intern, you will be working closely with members of our diverse team but have large independency at the same time.

5.3 Non-destructive Testing Reliability & Improvement

Team NRI consists of three groups of professionals who are active in testing & inspecting and advising our clients with regard to the condition and integrity of their electricity production facilities. This team offers internships on the following subject(s):

- Measurement & Testing (mainly diagnostics: physical measurement in both on-stream applications as well as during plant shutdowns: Non-destructive testing)
- Failure analysis , metallographic, mechanical inspection
- Fracture mechanical analyses, computer modeling (CFD and component life time modeling), design reviews, welding

5.4 Power Generation Modeling / Process Cooling Water

Team PGM/PCW focuses on the power output, efficiency and load following of (new) power generation plants and is active in the field of chemical water quality consultancy of process, cooling, waste and drinking water.

At this moment we are looking for an intern regarding the **data-mining tool MagicCorr®**.

5.5 Renewables & Environment

Team R&E focuses on greener energy (such as wind energy) and on health, sustainability & modeling. This team focuses on all aspects dealing with emissions to air and the application of byproducts from (mostly) coal-fired power plants.

At the moment we have no specific graduation assignments within team R&E.
Any suggestions? Please let us know.



6 **SUSTAINABLE USE (SUS)**

Business Line SUS provides services that focus on energy efficiency, decentralized energy infrastructures, and sustainability. SUS works for policy makers, policy implementers, and large end-users of energy to help them achieve their energy management and sustainability objectives. This business line provides value to its clients through strategic planning, market and technology research, implementation support, and performance measurement.

Since SUS is a growing market, it is not divided in teams yet.

Would you like to do your assignment on this subject, then suggestions of course are welcome!



7 TESTING, INSPECTION & CERTIFICATIONS (TIC)

Business Line TIC is esteemed as top service by the international world of energy. TIC is mainly pursuing tests on medium and high voltage components for the energy supply. TIC is divided in 6 teams.

7.1 Calibration & Metering

Team Calibration and Metering Laboratory, called C&M Lab, calibrates electrical, electronical, thermal and pressure measurement instruments. This is done for our own laboratories as well as for third parties. Further we perform Type Testing on kWh meters according to all international standards and we certify these products. Finally we control the metrological quality of all kWh meters in The Netherlands and we mediate in case of disputes.

For all these activities we operate in a well equipped laboratory complete with special instruments and standards.

At the moment this team has no internships available.

7.2 High Power Laboratory (HPL)

Our High Power Laboratory is a well-known independent laboratory for testing and certification of medium and high voltage components used in the electrical infrastructure. Our customers are manufacturers and utilities worldwide, in particular in Europe, Asia, America and the Middle East.

Our HPL issues Type Test Certificates and Test Reports for tests on cables, cable accessories, insulators, power transformers, instrument transformers, GIS, switchgear, panels and other components.

HPL offers internships on the following subjects:

- Simulation, design and testing of innovative measurement systems (hard- and software) to be used in the laboratory. Often these systems have very severe requirements regarding resolution, and/or bandwidth and/or accuracy and EMC, because they have to operate in extremely electro-magnetically polluted environment

- Design of software (tools) for the analysis of test-data. This may be test-result statistics, but also measured data from tests
- Assistance and support with design and installation of secondary equipment, supporting the main process of testing
- Modeling of future laboratory circuits and systems, eg. design of virtual laboratories for new applications, like high-voltage DC or modeling of existing generator power supply systems
- Design (by modeling) of new current interruption technology, eg. for high-voltage DC current interruption
- Evaluation and analysis of measured data for the use in international R&D and standardization committees

7.3 High Voltage Laboratory (HVL)

Our new High Voltage Laboratory, opened in 2009, is the largest commercially operated HV-laboratory in the world.



Today's economic climate demands fast, state of the art technology for the Certification of high and medium voltage components that are used in the T&D environment. Our HVL offers sufficient room for the preparation and implementation of test object. Next to that, HVL allows for greater mobility of the test object.

At the moment HVL offers an internship on “developments of binary symmetrical channel (bit error generator)”.

7.4 Inspections

Team Inspections is working by order of national as well as international electricity companies, manufacturers and heavy industrial workers. Our inspectors are doing all sorts of worldwide component oriented activities as part of the 'quality surveillance' cycle. Their work mainly consists of witnessing tests within the scope of quality control.

Team Inspections offers internships on the following subjects:

- Optimization of Business Administration within the inspection process by using modern, digital equipments
- How to integrate TT and/or FAT into QA/QC
- Set up of efficient certification model for Wind turbines

8 TRANSPORTATION SYSTEMS (TNS)

Business Line TNS offers specialized and innovative services to the rail branch, infrastructure owners, train operators and industry. Our main expertise is on the field of energy, electrical systems, command and signaling and operational control. Our services cover consultancy, engineering, assessments and certification.

Detailed knowledge and experience are the basis for the rail consulting and engineering services offered by DNV KEMA for:

- Rail power supply
- Contact line systems
- Return circuit, earthing and EMC
- Auxiliary systems
- Command, control and signaling
- SCADA and operations control centers
- Rolling stock technology and innovations
- Special software

The activities cover the full portfolio from systems approach down to detailed engineering. DNV KEMA has its -in house developed- own special simulation and design tools.

The entity Rail Transport Certification (RTC) is an independent entity aligned with TNS. Together with our office in Dresden we deliver services in Europe and abroad.

RTC is recognized as national body for the acceptance of rolling stock in the Netherlands and is active as member of the Organization NB Rail - comprising all notified bodies in the rail sector.

RTC services:

- Licensing of rolling stock
- Certification of components from the fields:
 - Energy
 - Infrastructure
 - Rolling stock
 - Environment
 - Command, control and signaling
 - Operation and maintenance

- Certification and safety assessments for:
 - ERTMS/ETCS
 - Interoperability components and subassemblies
 - Studies commissioned by The European Railway Agency and the European Commission
 - Development of international guidelines for certification

TNS offers internships on the following subjects:

- Develop an Excel-tool for the determination of protection relays setting for the high voltage installation and rectifiers of DC traction power substation and the delivery of the setting protocol for commissioning and monitoring.
- DC Stray current of DC traction power systems from source to victim systems. Based on the output of our existing tool Sinanet for the analysis of DC power system for the determination of the effect on other systems and infrastructure like cables, gas pipes, crossover, etc. An additional generic tool should be developed.

