A specialist energy consultancy

Electricity Networks

tneigroup.com
TNEI has in-depth knowledge and expertise in electrical networks, encompassing planning, design, modelling and analysis. We can support Network and System Operators (NO/SO) across a wide range of services, including:

- Transmission and distribution network modelling (from EHV transmission down to LV)
- Development of network master plans
- Integration studies for generation and other technologies, such as energy storage or STATCOMs
- Curtailment assessment of renewable generation
- Interconnection of bulk power grids
- Power system steady-state and security analysis
- Power system stability and controllability assessment
- Compliance with industry codes and standards
- Technical due diligence of renewable generation.

Our team of power system engineers have extensive experience in the modelling and design of electrical networks. We use power system analysis software (IPSA, Digsilent Power Factory, PSS/E, etc) to support our clients and perform complex analysis of network behaviour. We have experience in modelling all types of electrical network, from large interconnected transmission systems to small island networks. We regularly perform steady state and dynamic analyses to assess network capability and performance, analysing such things as frequency stability, sub-synchronous oscillations, voltage regulation and capacity to integrate renewable generation.

We regularly perform capacity assessments for integrating renewable generation connections, and undertake network planning studies to assess different methods of reinforcement or reconfiguration. More recently, we have been supporting clients on modelling lower voltage networks to a much more granular level to better understand the impacts of new technologies such as electric vehicles. TNEI also has a growing data science capability such that we can respond to industry requirements around the modelling of demand or renewable generation patterns.

As network operators focus increasingly on innovation and develop new methods of planning and operating their networks, our specialist team are able to offer wide ranging expertise. TNEI is supporting a number of distribution and transmission network operators in their network innovation ambitions, primarily in Network Innovation Allowance (NIA) and Network Innovation Competition (NIC) projects including Distributed ReStart, Smart Network Design Methodologies, Smart Street, and many more.

TNEI’s main clients are the electric utilities in the UK and Ireland, however we have also worked with NO/SOs around the world, including South Africa, Nigeria, Bangladesh, and China. The combination of our expert software (IPSA) and power system analysis teams provides TNEI with a unique capability to provide clients with bespoke analysis solutions.
Case studies

**Service:** Ongoing technical support to the Network Planning & Regulation teams in SPD and SPM
**Client:** SP Energy Networks

Since 2012, TNEI has been part of a framework providing ongoing technical support to the Network Planning & Regulation teams in SPD (Scotland) and SPM (Manweb), covering the EHVIHV distribution networks. The services provided encompass various forms of technical and techno-economic analysis and development of bespoke software models and tools to facilitate and streamline network design, connection and innovation within SPD and SPM.

Below is a summary of the wide-ranging support TNEI has provided to SP Energy Networks over the course of the framework:

- Strategic and technical analysis support for the development of SPEN's RIIO-ED2 and ED2 Business Plans;
- EHVIHV connection design and investment approval;
- EHVIHV reinforcement design and investment approval;
- Scripting and automation for improving the network design process;
- Novel algorithms and tools to equate/valued distributed fault-in-feeds across the 33kV mesh to equivalent in-feeds at 132/33kV supply points;
- Analysis of load indices in SPD;
- Modelling and development of technical specification for 132kV phase shifting transformer in SPM;
- Tools to streamline generation of Long-term Development Statement and National Grid Transmission data exchanges;
- Quantification of the level of risk associated with automatically correcting data errors in HV GIS circuit data;
- Network losses policy development;
- Assessment of strategic network transitioning from meshed to radial networks;
- Tools to characterise level of generation/demand opportunity across the network;
- Calculation of site-specific Line Loss Factors (LLFs) for customers in both the Scottish Power (SP) Manweb and SP Distribution licence areas;
- Support on innovation projects and bids e.g. Flexible Networks, ANGLE-DC – application of MVDC scheme, VISOR;
- Techno-economic analysis to underpin proposals for losses discretionary reward mechanism;
- Tool to assess optimal levels of HV automation to meet ILS reward criteria;
- Review and update of network connection and design policy to incorporate G98 and G99 changes; and
- EHVIHV network modelling to inform NGESO Voltage Pathfinder in Mersey region.

**Service:** Assessment of Variable Renewable Energy Grid Integration in Pacific Island Countries
**Client:** World Bank

TNEI, as part of a larger consortium, was commissioned to provide support to address a number of specific operational concerns identified in the grid systems of a number of Pacific Island countries. These issues primarily related to dynamic stability, including frequency imbalance and loss of synchronisation, owing to insufficient spinning reserve and/or machines with inadequate Automatic Governor Control (AGC) and voltage regulator response. The impact of increased amounts of fluctuating inputs from renewable generation will exacerbate the issues faced by the electrical systems on the different islands and it was the objective of the overall study to gain a better understanding of them and propose mitigating solutions, such as the use of energy storage to provide frequency support.

Under this assignment, TNEI performed detailed power system modelling and analysis on seven Pacific Island country networks to assess and understand their capability to accommodate increasing penetrations of variable renewable energy (VRE), primarily solar PV. An inception mission allowed the collection of comprehensive sets of data and information and detailed Digsilent Power Factory power system models were created and/or updated.

The models were built and then a tuning exercise was carried out to ensure the networks were behaving as expected. Following this, a comprehensive set of steady state and dynamic studies were performed to analyse the stability of the small island networks (particularly frequency response) in the event of credible contingencies. The networks were stress-tested to determine how much VRE they could accommodate before they became unstable. In a number of cases, battery storage was proposed as a potential mitigating solution, and other solutions such as network reconfiguration were also suggested.

A stakeholder engagement mission was held at the end of the project with representatives from each of the utility companies on the different islands. TNEI presented the results of the studies and outlined the unique challenges for each network. A handover of the models was also performed, and instructions on how to run the study cases were provided to allow the in-country engineers to better plan and prepare their network for increased integration of renewables.

**Get in touch**

We are a specialist, independent company. That’s why we can offer a flexible, personal service and help our clients quickly and efficiently, without all the big corporate distractions.

**But most of all, we love to solve problems.**

For more information about our network modelling, design & analysis services, please contact Stephanie. Email: stephanie.hay@tneigroup.com or call: +44(0)141 428 3180.

**Key contacts**

**Stephanie Hay**
**Director of Networks & Innovation**

Stephanie is Director of the Networks and Innovation team at TNEI and has been with the company for over 5 years. Stephanie has been supporting clients through the energy transition, providing technical and market advice on emerging technologies and delivering concept, innovation and strategy projects for utilities and other industry organisations. Contact Stephanie to discuss innovation, strategy, regulation, network design and modelling solutions.

**Xuecheng Zhang**
**Specialist Consultant**

Xuecheng is a power system specialist with over 30 years’ experience in power systems computation and analysis including bulk power systems modelling and simulations, power system steady state and dynamic analysis, power system security and stability assessment, network planning and strategy development, planning and security of supply standards and grid code compliance.

He has published several papers for IEEE transactions and conference, and has been involved as a regular reviewer in reviewing papers for IET Generation, Transmission and Distribution Journal.
Strategy & Regulation

The challenges facing the electricity industry are significant. Regulations are constantly evolving, as market conditions change and reforms are implemented. New technologies are introduced throughout the supply chain and each one brings new risks and opportunities. Meanwhile, policymakers strive to provide the right conditions to enable the energy trilemma: high security, low prices, and a sustainable future.

Businesses need to have the right plans in place to be successful and competitive in this ever-changing market and regulators need to stay one step ahead to make sure that, despite all of this complexity, consumers have reliable access to electricity at an appropriate cost. TNEI works with network operator clients to provide a range of services in the markets and regulation space. We offer advice and external assurance on various regulatory aspects of their business, most prominently on RIIO price control business planning and associated mechanisms.

Our understanding of network charging is also extensive, whereby TNEI have been working closely with an economic partner with whom we are jointly responsible for building, maintaining, and adapting DCUSA’s Distribution Use of System (DUoS) charging models. We have also undertaken numerous technical and market assessments for public sector industry organisations, such as Scottish Enterprise, who use these assessments to inform local and national strategy.

Our engineering expertise helps regulators, governments and network operators decide the future direction of the electricity industry.

TNEI provides clear advice on electricity industry strategy and regulation to help organisations overcome these challenges. Our consultants draw on their comprehensive technical knowledge, significant project experience, and exceptional academic backgrounds to advise on everything from system operation to socio-economics. Our engineering expertise helps regulators, governments and network operators decide the future direction of the electricity industry. In turn, we use this knowledge to provide strategic advice to generators, suppliers and investors, helping them to remain competitive, now and in the future.

Our core expertise includes:

- Designing and developing the technical aspects of energy regulations and incentive mechanisms
- Techno-economic modelling to support network planning and operation
- Analysing markets and supply chains for new and existing technologies to identify barriers and opportunities for new entrants
- Advising owners and lenders on regulations which could affect their projects, and the strategies to adopt for minimising risk
- Network charging.

Key contact

Gordon McFadzean
Principal Consultant

Gordon leads the delivery of projects relating to electricity strategy and regulation. He has a good technical overview of the network planning and system operation challenges facing the energy industry, particularly in GB and Ireland, and regularly advises generation clients on strategies for getting connected to the grid.

He has a strong technical background in power systems analysis and power systems modelling and a good understanding of wholesale energy markets, ancillary service markets and network regulation, with a particular focus on use of system charging.

Get in touch

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