

# Advancing Renewable Energy

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## Power Systems Consulting



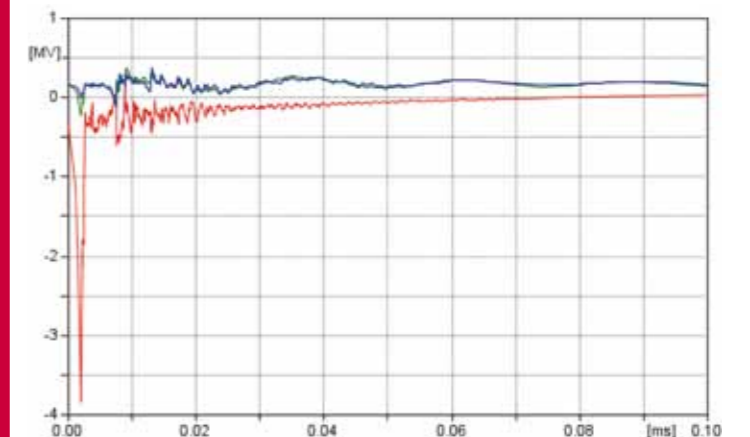
*Narec is an established provider of power systems consultancy to utilities, transmission and distributions owners and operators, and project developers.*

Narec helps ensure that design upgrades to the existing networks are reliable, efficient and safe. We assist with integrating new generation into transmission and distribution networks and in developing innovative solutions for future networks. This informs our approach to economic feasibility and market studies for new networks.

Our involvement in the test, research and development of new renewable generation, and transmission and distribution equipment, allows us a unique insight into these technologies and their effects on power systems.

### Technical Analysis Capabilities:

- Load flow and fault level analyses
- Transient stability studies
- Protection co-ordination
- Harmonic analyses
- Electromagnetic transient analysis (including lightning strikes, switching phenomena and insulation co-ordination)
- Field measurements and analysis of the associated data
- Techno-economic studies such as market studies, feasibility studies and cost-benefit analyses



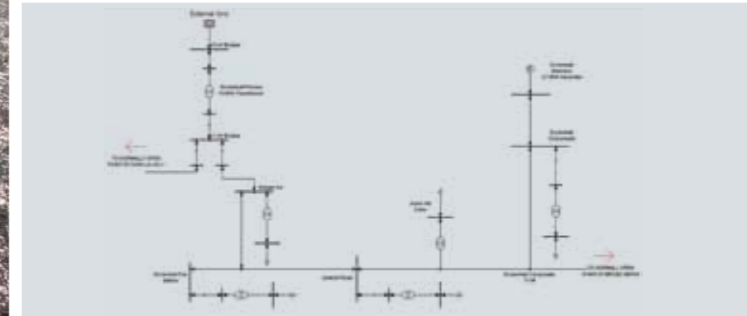
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## Sector Focus

### Power Generation

Electricity generation is becoming increasingly more diverse as renewable generation including wind, wave, solar and biomass is coming on-line, alongside traditional generation sources such as fossil fuel and nuclear.

Narec is assisting the power industry to integrate new generation by providing:

- Guidance through the grid connection process, including submission of a grid connection application;
- Feasibility studies to examine energy generation from renewable sources;
- Field measurements and data analysis to understand the effect of connecting distributed generation sources to the networks and associated grid issues.

### Industrial and Shipping

Narec provides consulting to companies in the oil and gas, chemical, manufacturing and shipping sectors. We also work with organisation on large sites such as hospitals, using industry standard software such as Dlg SILENT and ERACS .

Our work is aimed at optimising power system efficiency and maximising system reliability and power quality, thereby reducing costs. Some of the issues that industrial customers may be facing include:

- Incorrect tripping of relays and circuit breakers;
- Utility charging a power factor penalty;
- Overheating motors and transformers;
- Issues with power quality, e.g. flicker;
- Facility experiencing low voltages in peak periods.

Power systems consulting can improve efficiency in situations where the plant has undergone extension or new generators and motors have been added, or transformers upgraded.

### Transmission and Distribution

Narec works with transmission system operators to help ensure that equipment ratings are sufficient such that catastrophic failure does not result, which could lead to other equipment being overloaded and potentially causing cascading damage to the system.

To do this, we carry out insulation coordination analysis to examine the surge arrester requirements to provide adequate protection.

This involves:

#### Lightning Studies

- Use of ATP-EMTP – industry standard software
- Very detailed substation model is built – lightning impulses applied and voltages monitored
- Transient voltages are compared with equipment Lightning Impulse Withstand Level (LIWL)

#### Switching Studies

- Another type of fast transient study utilising ATP-EMTP
- Transient voltages are compared with equipment Switching Impulse Withstand Level (SIWL)
- Pole scatter of circuit breaker contacts taken into account

We also work at the distribution level to solve related problems and enhance distribution networks. This work might involve:

- Carrying out power system analysis work, including protection studies;
- Testing and analysing new technologies for use on distribution networks;
- Carrying out field measurements and analysing the associated data.

### Future Networks

As the level of renewable generation increases, the networks that enable connection of these sources to the grid become increasingly more critical to maintaining network stability and security of supply.

Narec is actively involved in the design of offshore networks and the network integration of distributed energy systems, while informing the power industry on topical issues, such as demand-side management, smart meters, supergrids and interconnectors, energy storage and HVDC issues.

#### Offshore Networks

Narec is involved in the design of offshore networks for both wind and marine technologies, considering issues such as:

- Determining the optimal voltage for offshore collector circuits;
- Technology selection such as quantification of the advantages and disadvantages of AC collector networks versus DC collector networks;
- Power quality assessment including voltage dips, flicker and harmonic distortion.

### Feasibility & Techno-Economic Studies

Our technical and market understanding of traditional and renewables power generation equips us to undertake economic feasibility and market studies. Detailed modelling work is performed to understand the economic feasibility of engineering solutions and to examine the market for new engineering products. These studies are particularly relevant in the area of renewable generation and future networks, to inform projects as techniques, processes and products are new and constantly evolving.

### Integrating Distributed Energy

Narec is helping project developers to understand the wider impacts of integrating distributed energy generation on the grid.

Our consultancy offering includes:

- Fault current reduction strategies to enable increased connection of embedded generation;
- Development and evaluation of network protection systems to allow for increased connection of renewable generation to the distribution networks;
- Insulation coordination studies for the upgrade of the UK's transmission networks to increase network transfer capacity from remote renewable generation locations to the load centres;
- G83/1 and G59/1 compliance testing;
- Carrying out field measurements and analysing the associated data.

