

POWER NETWORKS

Power System Protection

Overview

PSC's protection engineers offer extensive expertise and experience in fault analysis, protection studies, design, relay settings, and commissioning supervision. PSC's engineers' experience includes distribution, transmission and industrial networks, and involvement in generation connections including both onshore and offshore wind farms.

PSC can perform protection grading studies and calculate relay settings to ensure that in the event of a fault, the correct protections should operate, isolating only those parts that should be disconnected, protecting the plant and network, and in compliance with relevant grid code requirements. In the event of a fault, PSC can undertake fault investigation, analyzing the records to establish the cause and make recommendations for the future.

Key capabilities

- Fault preparation and analysis
- Preparation of protection key line diagrams
- Preparation of technical specifications
- System modeling and protection grading studies
- Preparation of protection policies
- Tender assessment
- Calculation of protection relay settings
- Detail design
- Witnessing of factory testing
- Commissioning supervision

PSC experts

Our Power System Protection specialists have both a broad view of the electricity domain, and a deep knowledge of system protection. A sample of our experienced Protection Engineers are listed below:



Richard Adams is a Chartered Engineer and a Fellow of the IET (FIET) with over 30 years of experience in the design and application of protection relays and systems at all voltages up to 500 kV. He is an active member of CIGRE, culminating in his appointment as Secretary of Study Committee B5 (Protection and Automation) in 2018. Richard is authorized to NGET TP141 for the preparation and checking of protection settings on the National Grid transmission system.

Mikhail Lukianenko is a senior consultant with over 15 years of experience in the field of substation protection and control systems up to 500 kV. His skills set allows him to independently perform any work related to relay protection, whether it's short-circuit study, protection calculation, relay parameter settings configuration, creating protection design documentation, design audit, or commissioning.

Chin Choo is a Chartered Engineer and brings over 16 years of experience working at New Zealand's generation and distribution utilities. Chin specialises in power system protection. She is a current member of CIGRE, representing PSC Australia for CIGRE Australia B5 (Protection & Automation). She has in-depth knowledge of protection and control schemes, having reviewed/prepared protection study reports, protection single line diagrams, relay settings including switchgear controls and schematic drawings. Chin also has extensive knowledge of IEC 61850 Substation Network Communications protocol for exchange of information between IEDs & SCADA as well as using Generic Object-Oriented Substation Event (GOOSE) messaging for switchgear interlock functions and inter-tripping.

PSC projects

A selection of projects* which demonstrate our Power System Protection experience is shown below.

Protection review and settings for a large scale Hydro generation plant, NSW

The scope of work included a review of the existing design and calculation of new settings to accommodate a generation capacity increase. The studies also included a Pole slip study and derivation of new pole slip settings and checking compliance with the Generator Performance Standard (GPS).

Protection settings design for a 30MW diesel power station, NSW

The project included a review of the existing Protection schemes and checking compliance with a new GPS. New settings for over and under frequency and voltage were required.

Review of the protection standards for a large scale generator and provide commentary and recommendations on the alignment with industry best practice

The project allowed the client to have confidence their current design standards are consistent with industry best practice. The project also included a site specific review of installed systems and recommendation for improvements to ensure alignment with their standard.

Hare Hill Extension Wind Farm, UK*

A protection grading study for the Hare Hill Extension Wind Farm in Ayrshire, Scotland, with the site consisting of 36 Wind Turbine Generators, totaling 29.75 MW connected to the 33 kV Distribution Network Operators system.

Dorenell Wind Farm, UK*

Production of a protection philosophy document and protection key-line diagram to outline the protection requirements from the 132 kV connection point to 33 kV switchboard to which the turbine strings are connected.

Syngenta CHP, UK

Design review of proposed modifications following protection operation and commissioning supervision.

Utility Protection Policy, Code of Practice Update and Operational Audit of Procedures, Oman*

Responsible for the preparation of a complete suite of Protection Policy/Code of Practice documents and functional specifications for 33 kV and 11 kV protection on distribution network. This additionally included an assessment of the impact of change in network operational practice from radial to parallel operation. Further work included a review of operational practices, settings management, commissioning and maintenance practices, policy compliance technical competence of staff following regulator's audits.

Utility Protection Audit, Australia

Examination and review of a selection of 33 kV to 400 kV feeder, transformer and busbar protection schemes, both new build and old, for compliance to present technical rules.

Ørsted - Protection Engineer consultancy

Provide protection engineer support to develop standard project documentation (tender/specification/testing requirements) for AC and HVDC connected wind farm projects in the USA.



Utility Protection and Control Design Support, UK*

Provision of protection and control design support across voltages from 33 kV to 400 kV for a period of up to one year to cover for staff temporary absence. The work covered all aspects of protection and control including update of policy documents, production of scope documents for Load Management Schemes to protect the network in areas with numerous distributed generation connections, input to costing for Load Management Schemes, and attendance at site visits where required.

Utility Protection and Control Design Support, UK

Provision of protection and control design support for a new 132 kV substation project. As an island network, connected to mainland UK by HVDC connection and with wind farms also on the island the low fault levels presented some challenges for the protection design and settings.

Stantec, UK

Engaged on several projects to provide protection support to FEED for new grid connections, checking of protection settings and updated diagrams for SVC earthing/auxiliary transformer replacement and design input for a circuit breaker replacement project (updated circuit and wiring diagrams).

Siemens, UK

Engaged on several projects to either assist with checking of protection settings or produce and check protection settings and manage submission of the settings and relay files to National Grid via their web-based repository. The work also involves liaising with National Grid engineers to achieve Assurance of settings prior to factory testing and commissioning. The work enables the client to better manage their resources and workload peaks.

Siemens Energy, UK

Responsible for production checking and Assurance of protection relay settings for a complete substation rebuild and associated remote end protections, managing submission of the settings and relay files to National Grid via their web-based repository.

Confidential Client, Cyprus

Undertook a review of protection settings and made recommendations for changes following reorganization of the electrical network.

Blue Transmission Ltd, UK

Engaged to investigate a protection operation following a system fault, since the tripping was not as expected, and discrimination lost, isolating a wind farm unnecessarily. Having carried out the investigation, the next step was to review the settings/fault levels and make recommendations for revised protection settings to be applied.

Ramboll, Denmark*

UK staff engaged by Ramboll in Denmark to review a protection maloperation which resulted in a fire on an offshore substation for a large wind farm. The review identified that the root cause of the incident was a cable failure which caused excessive arcing and was not cleared due to faulty protection design principles.

Ramboll, Denmark*

UK staff have provided support to Ramboll, Denmark by producing a protection key-line diagram for a US offshore wind farm currently under design/development.

ENTSO-E, Sweden, Finland, Norway and Denmark*

Study for harmonization of under frequency load shedding (UFLS) policies for Norway, Sweden, Denmark and Finland, considering the impact of high renewable penetration on heavily interconnected networks and its effective rollout against European Commission (EC) regulation. Stakeholder engagement within the Nordics including Regulators, DSO's and the implementing TSO's led to the Nordic position paper that sets out the Nordic TSO's common position to the UFLS scheme as part of the requirements of EC.

Review of protection systems for large hydro generator

PSC provided services for review and calculation of protection systems for a large hydro generator in Australia, including:

- Generator Differential
- Stator earth fault (including neutral voltage, third harmonic and sub harmonic injection)
- Over fluxing
- Over and under voltage
- Over and under frequency
- Accidental energization
- Dynamic breaking overcurrent
- Coordination of overcurrent and earth fault protection (including fuses) on auxiliary systems
- Assessing GPS and NER compliance

We also reviewed protection policies and standards, and identified improvement opportunities for alignment with standard engineering practice.

Elstree Substation, UK*

PSC were engaged to undertake protection design modifications and relay settings associated with four 275/132 kV supergrid transformers, as well as preparation of relay settings for new relays and assessment of settings for existing relays affected by changes to instrument transformers. Approval of relay settings in accordance with TSO processes and submission into their web-based system.

Protection studies for large iron ore mine

PSC completed protection and arc flash studies as part of the overall power system studies for the addition of the WHIMS (Wet High Intensity Magnetic Separators) at the Roy Hill Iron Ore Mine. Protection studies included overcurrent and earth fault protection settings for the new 33 kV, 6.6 kV and 0.4 kV plant as well as confirmation that the proposed fuses for VSDs and other equipment were appropriate. Following the protection setting studies, arc flash analysis was carried out at the new 33 kV, 6.6 kV and 0.4 kV plant to determine the appropriate level of PPE required while working in the vicinity of the equipment while live.

East Anglia 1 ITT Technical Due Diligence, UK*

Review of factory and site acceptance test documentation for protection and control and SCADA systems (onshore and offshore) to see that sufficient evidence exists to establish that suitable processes were undertaken prior to putting into service and identify any shortfalls for follow-up.

Protection Grading Studies for Cotton Valley, Kings Lynn, Kemsley Paper Mill, UK

PSC developed multiple system models in DigSILENT Power Factory and delivered protection settings analysis to report any changes necessary to improve protection system performance and to provide appropriate coordination between different protection devices.

Protection Grading Review and Arc Flash Hazard Assessments for BHP Nickel West, Australia

PSC has considerable experience working with BHP sites' models using DigSILENT PowerFactory and has been developing the power system network models' integrity, after which PSC was selected as the custodian of the models. PSC developed a Basis of Study (BoS) document for the preparation of power system studies, protection grading review and arc flash risk assessment according to IEEE 1584-2018 to facilitate a consistent work practice that assisted with the quality of the study outcomes. Provided multiple comprehensive reports with protection time grading studies, arc flash hazard assessments and mitigation strategies to address high fault arc levels.

Protection Studies and Settings Configuration for Yurika BESS Facilities, Australia

PSC was engaged to provide protection studies and protection settings for BESS facilities that grade with the upstream NSP protection device.

Protection System Audit for Territory Generation, Australia

PSC was engaged to review the existing protection schemes and settings to achieve operational plant stability. Works included a review of the protection single line diagram, fault study, protection settings and logic block diagrams.

** Experience gained at Ramboll Energy UK Power Systems prior to acquisition of the group by PSC.*



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