European Research Infrastructure supporting Smart Grid Systems Technology Development, Validation and Roll Out

TRANSNATIONAL ACCESS PROVISION

RESEARCH INFRASTRUCTURE DESCRIPTION AND
TRANSNATIONAL ACCESS CONDITIONS

Power Networks Demonstration Centre

UNIVERSITY of STRATHCLYDE
POWER NETWORKS
DEMONSTRATION CENTRE

Grant Agreement No:	**654113**
Funding Instrument:	**Research and Innovation Actions (RIA) – Integrating Activity (IA)**
Funded under:	**INFRAIA-1-2014/2015: Integrating and opening existing national and regional research infrastructures of European interest**
Starting date of project:	**01.11.2015**
Project Duration:	**54 month**

Project co-funded by the European Commission within the H2020 Programme (2014-2020)

1 Research Infrastructure

Name of Infrastructure/Installation	**Power Networks Demonstration Centre (PNDC)**
Location	Glasgow, United Kingdom
Web Site	*http://pndc.co.uk/*

2 Description of the Research Infrastructure

The demonstration network provides a flexible arrangement of the primary and secondary equipment that is required to represent typical rural, urban and suburban networks in the UK (11 kV and 400 V). The network can be supplied either directly from the grid or using a 5 MVA motor-generator set to allow both voltage and frequency variances to be evaluated.

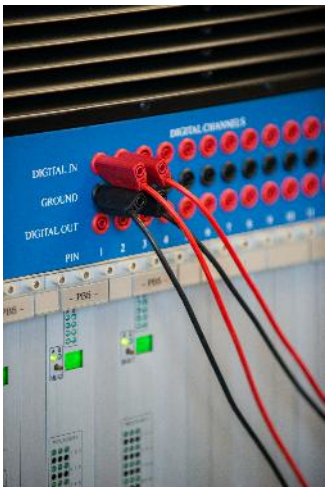
The network itself is built using a mixture of cables and overhead sections. Variable lumped impedance equivalents are used to provide a more dispersed network – within the footprint available. A primary substation replica allows for voltage control via on-load tap changers and automated ring main units; these are used throughout the network. The network has fibre-optic communications throughout, as well as easily accessible connection points to allow quick changeover between communications systems.

The capability to apply resistive balanced and unbalanced faults at both voltage levels is also present.

In addition to the standard operator instructions through the SCADA system, references for the grid interface controls can be supplied from recorded profiles through a real-time digital simulation platform. This allows for the examination of the wider impacts of operational strategies and technologies beyond the section of network physically constructed. There is also a high-speed measurement and data-logging system installed in parallel to the SCADA in order to provide better granularity and further understanding of system behaviour.

In order to achieve accelerated testing, the RI is underpinned by the following main systems:

5MVA motor-generator set and 600kVA controllable load banks
Power to the test network can be is typically supplied from a 5MVA motor-generator (MG) set. This allows for voltage and frequency control of the network independent of the public grid supply. The MG set can be controlled either through SCADA or through an interface with the centre's RTDS. 600kVA, 0.8pf lag worth of load is dispersed throughout the network and is controllable to obtain the desired load profile over a period of time.



6-rack RTDS system
The centre has an up to date 6-rack RTDS with a range of I/O capabilities including hard-wired analogue and digital I/O, DNP3 and IEC 61850 SV & GOOSE communications.

Distributed high accuracy, fast data acquisition system
High accuracy instantaneous MV and LV voltage and current measurements can be collected at rate of up to 10kHz (samples are synchronised globally) using a distributed data acquisition system. The system is modular, so additional measurement nodes can be added where required. Furthermore, the platform can also be used to deploy control functions where control commands can be distributed at the measurement nodes.

MV and LV fault throwers
Phase to phase and earth resistive MV faults and solid LV faults can be applied to the test network at different locations. These allow the characterisation of the fault response of devices under test. This capability addresses the issue of having to wait for real faults to occur during a field trial of a piece of equipment connected to a real network.

3 Services offered by the Research Infrastructure

Grid integration, characterisation and functional testing of smart grid components and systems
Rigorous functional and performance testing of systems and components connected to MV or LV can be achieved. These undergo a test regime that is agreed beforehand with the user. The test network offers flexibility in the test conditions in terms of currents, voltages, frequency and network topology. SCADA integration can also be achieved over a wide range of industry standard communication protocols.

Hardware in the loop testing of control, protection and automation equipment
Equipment that is not network ready can be tested using the RTDS in a hardware in the loop configuration. The RTDS can also be interfaced to a system under test that is partially connected to the test network. The RTDS offers a rich library of power system and control components.

Inverters characterisation and testing
This utilises 10kW programmable DC power supplies with solar array simulation. The inverters can then be subjected to different load and fault conditions while measuring their outputs including harmonics.

Testing of sensors
MV and LV sensors can be subjected to realistic operating conditions, both steady state and transient. Outputs of the sensors can be integrated through the PNDC SCADA infrastructure and/or the distributed data acquisition system.

4 Brief description of the organization managing the Research Infrastructure

The Institute for Energy and Environment (InstEE) represents one of Europe's largest power systems and energy technology university research groups. Comprising 32 members of academic staff, over 200 research staff and students, and 18 technical and administrative colleagues. The PNDC complements the InstEE D-NAP Dynamic Power Systems Laboratory. The PNDC focuses on mid-TRL testing and innovation projects in partnership with industry.

5 Transnational Access conditions offered by PNDC

Induction and safety:

The users will be inducted to the facility and a risk assessment of the work is expected to be in place at least two weeks prior to the commencement of work.

For **safety reasons**, any **work involving live equipment**, is not to be operated by the users themselves; experimental tests will be carried out by PNDC technical and research staff. Access to simulators, or other preparatory work not involving live equipment, will be granted, provided necessary reservations have been made in advance by the users by consulting with the PNDC project lead. The **scheduling of the experiments** will be agreed and booked prior to the stay according to the availability of the involved staff and equipment. Administrative documentation for the access (contract, non-disclosure agreement, etc.) will comply with ERIGrid common indications.

The access being offered includes supervision and help of PNDC staff:

- As a complement to the pre-access contacts between the user group and PNDC, the stay will start with an introductory meeting with a senior researcher for confirming the stay conditions (confidentiality, safety indications), scheduling the activities, explaining the on-site procedures, clarifying the logistics and technical details.

- Preparatory work: a laboratory technician will assist the users for the installation of the devices, electrical connections, use of the specific instrumentation, preparation of a test procedure (if necessary) on the basis of the users' requests, and programming of the experimental conditions.
- PNDC researchers will support the realisation and follow-up of the experiments.
- PNDC researchers will support the results interpretation, data processing and analysis, and test report preparation.
- It is expected that the work undertaken at the RI is disseminated. Previous collaborative visits to the RI have resulted in reputable journal and conference publications.

Reimbursement of expenses:

User expenses for the Transnational Access are paid by ERIGrid (EU H2020 Programme). This includes travels to PNDC by plane (economy), accommodation, daily subsistence, and daily transportation during the stay.

6 Contact details for Research Infrastructure

<table>
<tr><td colspan="4">Power Networks Demonstration Centre (PNDC) – University of Strathclyde
Address: 62 Napier Road, Wardpark, Cumbernauld, G68 0EF, United Kingdom
Website: http://pndc.co.uk/</td></tr>
<tr><td colspan="2">For Management/Organization Issues:</td><td colspan="2">For Technical issues:</td></tr>
<tr><td>Federico Coffele

Tel.: +44 1236617162
E-mail: federico.coffele@strath.ac.uk</td><td>  </td><td>Ibrahim Abdulhadi

Tel.: +44 1236617176
E-mail:
ibrahim.f.abdulhadi@strath.ac.uk</td><td>  </td></tr>
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