Power Potential

DER Test Specification v1.2.4

June 2020

Contents

1. Introduction

The Power Potential project (previously called the Transmission and Distribution Interface 2.0 project) is a joint effort between National Grid Electricity System Operator (NG ESO) and UK Power Networks (UKPN) to find an innovative solution to technical constraints experienced at the transmission level.

The project is focused in the South-East area of England and there are four existing Grid Supply Points (GSP) in scope for the project: Bolney, Ninfield, Sellindge and Canterbury North. The transmission network, and the areas within the distribution network at this location are at the limit of capacity for transferring generation away from the area. This means for particular faults or conditions on the transmission network, voltage levels at certain points could reach values that can violate statutory voltage limits. This constraint is preventing additional generation from being able to connect to the South-East transmission or distribution networks. To enable more generation to connect, large-scale network investment is traditionally required. The Power Potential project aims to help manage transmission constraints by providing power services to the NG ESO from Distributed Energy Resources (DERs) connected to UK Power Networks' distribution network. This will ultimately facilitate faster and cheaper alternative DER connections and will reduce the operating costs currently being incurred in managing the existing limitations in this area.

The project aims to create a regional reactive power market for the first time in the world which will help defer network reinforcement needs in the transmission system. DER can also bid for active power services in the Power Potential project. The project has the following key deliverables:

1. A commercial framework using market forces to create new services provided from DER to National Grid ESO via UK Power Networks.

2. A technical and market solution known as the Distributed Energy Resources Management System (DERMS) to support technical and commercial optimisation and dispatch. It includes gathering bids from DER and presenting an optimised view of the services to NG ESO split by GSP. The DERMS will be installed in the UKPN's control room.

Figure 1 presents the operation of major components from the Power Potential control system between National Grid ESO, UK Power Networks and DER.

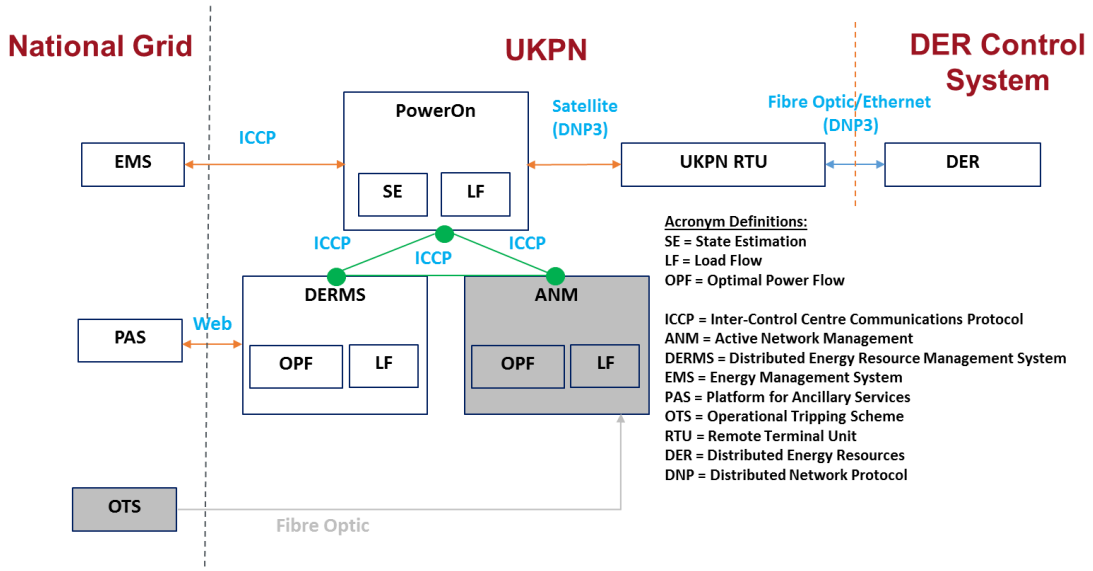


Figure 1 - Power Potential main communication paths between National Grid ESO, UK Power Networks and DER

2. Purpose of this document

This document presents the DER Test Specification details for the DERMS deployment, specifically the testing required between UKPN Remote Terminal Unit (RTU) and DER.

The test scope includes real time data exchange between UKPN RTU and DER (non-functional), as well as DER capability/performance test (functional). The test specification, as set out in this document, includes the following components:

1 DER control system

2 UKPN RTU

The DER Test Specification defines a suite of tests used to ensure that all functions as described in the *DER Technical Requirements* document are met. The test specifications provide an overview of the test procedure and details the individual tests performed at each stage of testing. A detailed test procedure is in a separate internal document *"DER Commissioning Test Procedure*" [1] and *"DER Commissioning Test Requirements*" [2]. The commissioning document consists of procedures that are associated with on-site testing only.

The complexity of the deployed DERMS control system (i.e. the number of measurement points, thresholds and generators) and the resulting multitude of possible states mean that the tests outlined in this specification are designed to be representative in that, while all functions are tested, they do not necessarily cover every possible combination of conditions for each system component.

This document will capture the following for each of the test cases:

1 Requirements and description of test case

2 Input data required for the test

3 Steps to conduct the test (outline only, detailed steps will be in the DER Commissioning Test Procedure document)

4 Expected output/results

The DER Test Specification herein does not include:

1 The market system, commercial framework design and other DER user interface related tests for DERMS

2 DERMS to DER aggregator interface

This document is applicable to all DERs whether they are operating under Voltage control mode (V mode) or Power Factor control mode (PF mode) as indicated in their DER Framework Agreement and connection agreement (default mode). However, please note that in order to provide reactive power services in Power Potential project, the DER must be instructed (armed) to operate in V-mode. However, if DER bids for only active power service, the DER mode of operation will be the same as its normal operation mode (default mode).

3. Test Strategy and Environment Summary

UKPN has defined a test strategy for the overall Power Potential project in an internal document *"Power Potential Test Strategy"* [3]. As part of this strategy, this document includes two stages for the DER pre-commissioning including lab integration and on-site testing.

a. Lab Integration Testing

The purpose of laboratory testing environment is to bench test the integration and data exchange between UKPN RTU and DER control system as part of DER non-functional requirements described in the *"DER interface schedule"* [4]. These tests are listed below and detailed in Section 4.

1 RTU – DER Initialisation

2 RTU – DER digital input map

3 RTU – DER digital output map

4 RTU – DER analogue input map

5 RTU – DER analogue output map

The integrated system environment will be located at the UKPN test lab environment as shown in **Figure 2**. The UKPN test lab environment for the Power Potential solution, includes facilities for integration different customer specific site devices, which includes a UKPN RTU and the customer DER control system. It is strongly advised (but not a requirement for trial participation) that the DER test engineer will bring an actual DER controller (similar to the one available at their site) for UKPN lab testing. If it is not feasible for a customer to bring its controller to the UKPN lab, then a DNP3 Master simulator with all the I/O points mapped, can be used by customer to simulate the UKPN RTU and simulation results may be reviewed and confirmed by UKPN.

The UKPN lab test environment is a preferred environment for testing the UKPN RTU integration with the DER controller as full integration can be tested prior to on-site testing.

The tests carried out in this environment are detailed in Section 4.

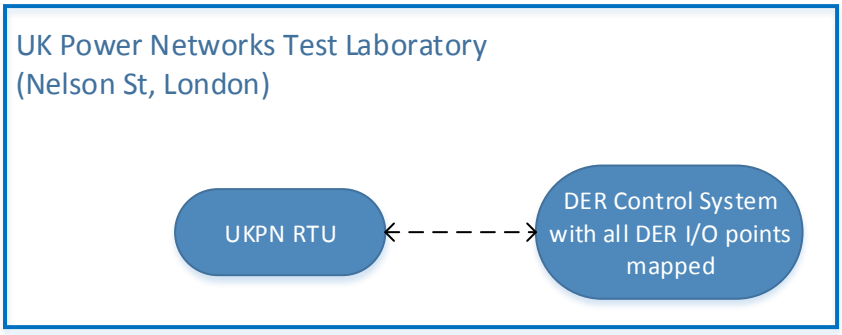


Figure 2 – Laboratory testing environment

b. On-site Testing

The DER capability (performance) testing will be carried out on site and defines a suite of tests to ensure that all functional requirement as described in the "*DER Technical Requirements* document" [5] are met. These tests are listed below and detailed in Section 5.

1 Reactive power capability tests

2 Voltage capability tests

3 Reactive voltage capability tests – Voltage setpoint

4 Active power capability tests

5 Active power – speed of response

The on-site testing environment is the operational environment used to carry out on site testing, where all the functional and site commissioning tests are performed. This environment, shown in **Figure 3**, includes the site RTU and the customer DER control system. The tests carried out on this environment are detailed in Section 4 and Section 5.

It should be noted that, the integration with National Grid Platform for Ancillary Services (PAS) system will not be tested as part of DER commissioning, but as part of separate test cycles.

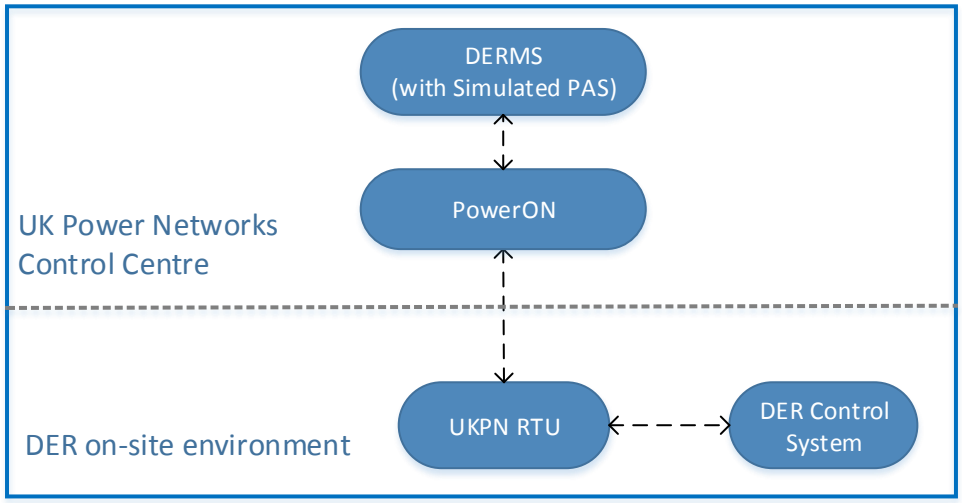


Figure 3 – On-site testing environment

After the above pre-commissioning tests stages completed, DER will be ready for commissioning. A summary of commissioning functional test procedures (not part of the scope of this document) which will be carried out on-site are listed below:

1 Integration checks as in laboratory testing

2 DER operational service including:

- Instruct (Arm) DER for only Reactive Power service or only Active Power service or both (depending on the DER service provision indicated in "DER Framework Agreement ")
- Instruct DER for Contractual mode

3 Loss of Communication with Customer's local control system

4 Failsafe due to non-compliance of DER

4. Integration Tests

This section covers the test cases associated to the UKPN RTU to DER control system integration. This is realised using DNP3 protocol where UKPN RTU acts as the master and DER control system acts as the slave. Tests are to be carried in both lab integration (not compulsory) and on-site (compulsory) environments.

4.1 RTU – DER Initialisation

Test Case Identifier	RTU_DER_1
Description	This test confirms that the RTU to DER interfaces restores to the normal status after an initialisation routine. This can happen during a power loss situation or an RTU restart scenario.
Pre-Requisites	1. RTU and DER are configured as per the engineering specifications and DER Interface Schedule and all the Inputs/Outputs (I/O) data are mapped. 2. DNP3 communication link is established between RTU and DER and there is a healthy poll established. 3. RTU Human Machine Interface (HMI) is available to view all the I/O points exchanged between RTU and DER. 4. Alternately if RTU HMI is not available a Distributed Network Protocol (DNP) traffic monitor like Wireshark can be used.
Inputs/Outputs (I/O)	All I/O points as defined in the "*DER Interface Schedule"* document [4] are configured.
Test Steps	1. Ensure RTU and DER are each communicating and the RTU local HMI is showing all I/O points in good quality (clear visibility). 2. Power off the RTU. 3. Power on the RTU, send any Binary Output command and send any analogue output command. 4. Turn power off to the DER control system. 5. Turn power on to the DER control system, send any Binary Output command and send any Analogue Output command from RTU HMI.
Expected Outputs	1. All the I/O points are displayed in RTU HMI with good quality after power cycling of RTU and DER. 2. DER can respond to the binary/analogue output command after power cycling of RTU and DER.
Test Environments	Lab and on-site

4.2 RTU – DER Digital Input Map

Test Case Identifier	RTU_DER_2
Description	This test confirms the RTU receives all appropriate digital inputs from the DER control system. These inputs inform the UKPN RTU on the successful receipt and execution of the control signal by the DER control system.
Pre-Requisites	1. RTU and DER are configured as per the engineering specifications and DER Interface Schedule and all the I/O data are mapped. 2. DNP3 communication link is established between RTU and DER and there is a healthy poll established. 3. RTU HMI is available to view all the I/O points exchanged between RTU and DER. 4. Alternately if RTU HMI is not available a DNP traffic monitor like Wireshark can be used. 5. DER control system should be able to force the signals that are mapped as Binary Inputs in UKPN RTU.
Inputs	All 'Binary Inputs' defined in the "*DER Interface Schedule"* document [4].
Test Steps	1. Ensure UKPN RTU and DER are communicating and the RTU local HMI is showing all Binary Input points in good quality (clear visibility). 2. Force all Binary Inputs to "0" state in DER control system, verify if the RTU HMI shows the correct status. 3. Force each Binary Input to "1" state separately in DER control system, verify if the RTU HMI shows the correct status. 4. Verify if the alarm state is displaying correctly (if configured for local HMI).
Expected Outputs	1. All the Inputs are displayed in HMI with good quality (clear visibility). 2. All the Inputs are mapped correctly between UKPN RTU and respond correctly to the state of change.
Test Environment	Lab and on-site

4.3 RTU – DER Digital Output Map

Test Case Identifier	RTU_DER_3
Description	This test confirms that the RTU can issue binary output commands to DER control system. The commands drive the DER to different conditions of operation that is desired by the UKPN DERMS. Also, these commands include signals that inform the DER about compliance to the active and reactive power services from UKPN's viewpoint.
Pre-Requisites	1. RTU and DER are configured as per the engineering specifications and DER Interface Schedule and all the input /output data are mapped. 2. DNP3 communication link is established between RTU and DER and there is a healthy poll established. 3. RTU HMI is available to send Binary Output commands for all points exchanged between RTU and DER. 4. Alternately if RTU HMI is not available there should be a way to send binary commands through the configuration/diagnostic tool of the RTU.
Inputs/Outputs	All 'Binary Outputs' defined in the "*DER Interface Schedule"* document [4].
Test Steps	1. Make sure RTU and DER are communicating and the RTU local HMI is showing all Binary Output points in good quality. 2. Send an on/latch on command separately for each of the Binary outputs. 3. For each Output verify if the DER control system received the signals and responds to the command. 4. Send an off/latch off command separately for each of the Binary outputs. 5. For each Output verify if the DER control system received the signals and responds to the command.
Expected Outputs	1. All the Outputs are correctly mapped between UKPN RTU and DER. 2. DER control system responds correctly to all the commands.
Test Environments	Lab and on-site (Note in on-site testing we may need to coordinate with the customer to make sure all commands do not cause any operational safety issues)

4.4 RTU – DER Analogue Input Map

Test Case Identifier	RTU_DER_4
Description	This test confirms that the RTU receives all the analogue inputs correctly from DER control system. These inputs inform the UKPN RTU on whether the various setpoints requested by UKPN for DER control were successfully received and executed by DER control system.
Pre-Requisites	1. RTU and DER are configured as per the engineering specifications and DER Interface Schedule and all the input /output data are mapped. 2. DNP3 communication link is established between RTU and DER and there is a healthy poll established. 3. RTU HMI is available to view all Analogue Input points exchanged between the RTU and DER. 4. Alternately, if RTU HMI is not available a DNP traffic monitor like Wireshark can be used. 5. DER control system should be able to force the signals that are mapped as Analogue Inputs in UKPN RTU. For Readback of setpoints and operational limits, we may need to send the analogue output commands to drive different values and this test case can be combined with the Analogue Output test case.
Inputs	All 'Analogue Inputs' defined in the "*DER Interface Schedule"* document [4].
Test Steps	1. Make sure RTU and DER are communicating and the RTU local HMI is showing all analogue input points in good quality. 2. Force each Input to 0% of full scale in DER control system, verify if the RTU HMI shows the correct value. 3. Force each Input to 50% of full scale in DER control system, verify if the RTU HMI shows the correct value. 4. Force each Input to 100% or maximum output of full scale in DER control system, verify if the RTU HMI shows the correct value. 5. Verify if the alarm state is displaying correctly if configured for Local HMI. Note: To test the readback for setpoints and operational limits, we must send analogue output commands for those points from the UKPN RTU.
Expected Outputs	1. All the Inputs are displayed in HMI with good quality (clear visibility). 2. All the Inputs are mapped correctly between UKPN RTU and DER and respond to the value in DER control system.
Test Environments	Lab and on-site

4.5 RTU – DER Analogue Output Map

Test Case Identifier	RTU_DER_5
Description	This test confirms that the UKPN RTU can send analogue output commands to DER control system. These commands are operational limits and setpoints that are desired by the UKPN DERMS. These commands are very important for the P/Q services.
Pre-Requisites	1. RTU and DER are configured as per the DER Interface Schedule and all the input /output data are mapped. 2. DNP3 communication link is established between RTU and DER and there is a healthy poll established. 3. RTU HMI is available to send Analogue Output commands for all points exchanged between RTU and DER. 4. Alternately if RTU HMI is not available there should be a way to send analogue commands through the configuration/diagnostic tool of the RTU.
Inputs/Outputs	All 'Analogue Outputs' defined in the "*DER Interface Schedule"* document [4].
Test Steps	1. Make sure RTU and DER are communicating and the RTU local HMI is showing all Analogue Output points in good quality. 2. Send a 0% command separately for each of the Analogue Outputs. 3. For each output verify if the DER control system received the signals and responds to the command. 4. Send a 50% command separately for each of the Analogue Outputs. 5. For each output verify if the DER control system received the signals and responds to the command. 6. Send a 100% command separately for each Analogue Outputs. 7. For each Output verify if the DER control system received the signals and responds to the command.
Expected Outputs	1. All the Outputs are correctly mapped between UKPN RTU and DER. 2. DER control system responds correctly to all the commands.
Test Environments	Lab and on-site (Note in on-site testing we may need to coordinate with customer to make sure all commands do not cause any operational safety issues)

5. DER Capability/Performance Tests

The tests presented in this section covers the scope of DER capability/performance. These tests are carried out on site after the DER and RTU integration is complete in the lab (laboratory pre-commissioning testing is advisory but not adequate for commissioning). The customer may have performed similar tests with DER and its control system and those test sheets can be used as a reference.

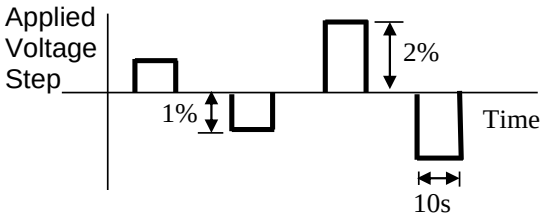
The Reactive power capability tests are required for DER to participate in the Reactive Power service (all DER). The Active power capability tests are required for DER wishing to participate in the Active Power service (as indicated by the DER).

5.1 Reactive Power Capability Tests

Test Case Identifier	DER_Capability_Reactive_Power_1
Description	The capability is measured at the Point of Connection (PoC) to the network and applies to the DER rather than component parts. The Reactive capability testing is arranged with the 'UKPN control centre' at a mutually agreed time. The test will be carried out under instruction from the UKPN control engineer and should be monitored and recorded at both the 'UKPN control centre' and by the DER owner.
Pre-Requisites	1. RTU and DER control system are fully integrated and testing completed. 2. Local HMI are available for changing the different control conditions and getting the feedback. 3. DER Active power level, if it can be changed, is at a level to give maximum possible 'Reactive' range during the test (maximum possible acceptable to the customer on the day of testing, but not requiring the customer to change their Active power level for this test). Refer to customer PQ envelope for relationship between active power level (P) and Q range.
Inputs/Outputs	*The outputs are listed below:* 1. Maximum DER Reactive power limit reached (Lag) at the Active power level at the time of the test 2. Maximum DER Reactive power limit reached (Lead) at the Active power level at the time of the test
Test Steps	1. Put the DER in 'Voltage' Control mode. 2. Adjust the 'Voltage' Setpoint such that the 'Reactive' power is driven to Maximum lag value. 3. Maintain status quo for 5 minutes. 4. Adjust the 'Voltage' Setpoint such that the 'Reactive' power is driven to Maximum lead value. 5. Maintain status quo for 5 minutes. 6. Switch back to original Voltage Setpoint. 7. Repeat steps1-8 if 'Active' power level changes. 8. Put the DER in 'Default' mode (as indicated in "*DER Framework Agreement and Connection Agreement*").
Expected Outputs	Verify the following: 1. DER can generate the Maximum allowable leading and lagging 'Reactive' power at the active power level(s) possible for the generator at the time. 2. Verify the 'Voltage Reference' and system voltage at 'PoC' and see if there is any violation (e.g. ± 6% for the 33kV or ±10% for the 132kV voltage levels).

Test Environments	On-site (Note in on-site testing we may need to coordinate with customer to make sure all commands do not cause any operational safety issues)

5.2 Voltage Capability Tests

Test Case Identifier	DER_Capability_Voltage_1
Description	These tests are to verify that the DER is equipped with a continuously-acting automatic voltage control that meets the requirements explained in the DER Technical Requirements document. The tests require the application of a voltage step to the DER reference voltage target. 
Pre-Requisites	1. RTU and DER control system are fully integrated and testing completed. 2. Local HMI are available for changing the different control conditions and getting the feedback. 3. Put the DER at as close as possible to 60% 'Active' power range, or other Active power range agreed with the DER consistent with capability offered in its framework agreement and current operating conditions.
Inputs/Outputs	*The outputs are listed below:* 1. These tests will examine the response of DER to external 'Voltage Step Changes' caused on the distribution network. 2. Dynamic Voltage response of DER: achieving 90% of the Steady State Reactive power change calculated from declared voltage slope within 2 seconds.
Test Steps	1. Put the DER in 'Voltage' mode. 2. From local HMI verify that DER is operating in 'Voltage' mode. 3. Alter the 'Voltage' Setpoint to + 1%. 4. Wait for the response to settle (e.g.10seconds). 5. Alter the 'Voltage' Setpoint to -1%. 6. Wait for the response to settle. 7. Alter the 'Voltage' Setpoint to + 2%. 8. Wait for the response to settle. 9. Alter the 'Voltage' Setpoint to - 2%. 10. Wait for the response to settle.
Expected Outputs	Verify the following: *(The following data must be recorded and submitted to UKPN)* 1. kW – 'Active' power at the applicable measurement point 2. Kvar – 'Reactive' power at the applicable measurement point 3. 'Voltage' at controlled busbar, usually the PoC 4. 'Voltage Setpoint' or 'Voltage Reference' 5. Power Factor (if relevant) 6. Voltage slope
Test Environments	On-site (Note in on-site testing we may need to coordinate with customer to make sure all commands do not cause any operational safety issues)

5.3 Reactive Voltage Capability Tests – Voltage Setpoint

Test Case Identifier	DER_Capability_Voltage_3
Description	These tests are to verify that the DER is equipped with a continuously-acting automatic voltage control that meets the requirements for the Reactive power service defined in this document. The tests require the application of a voltage step to the DER reference voltage target. A new voltage reference setpoint will be issued to the DER control system and UKPN will measure how long it took for the DER control system to receive the new instruction and how long it takes for the new voltage setpoint to be achieved at the DER PoC.
Pre-Requisites	1. RTU and DER control system are fully integrated and testing completed. 2. Local HMI are available for changing the different control conditions and getting the feedback. 3. Put the DER as close as possible to 60% 'Active' power range, or other Active power range agreed with the DER consistent with capability offered in its framework agreement and current operating conditions.
Inputs/Outputs	*The outputs are listed below:* 1. These tests will examine the response of DERMS and DER to 'Consistent' External Voltage Step Changes caused on the distribution network. 2. 'Voltage' Setpoint achieved at DER PoC and in desired speed (see **Figure 4**). 3. Dynamic Voltage response of DER: achieving 90% of the possible change from full lead (importing Reactive power) to full lag (exporting Reactive power) within 2 seconds.
Test Steps	1. Put the DER in 'Voltage' mode. 2. From local HMI verify that DER is operating under 'Voltage' mode. 3. Make a 'Voltage' Setpoint change of say +3 % (or as close as possible). 4. Wait for the DER response to settle. 5. From local HMI verify that DER is operating under 'Voltage' mode. 6. Make a 'Voltage' Setpoint change of say -3 % (or as close as possible). 7. Wait for the DER response to settle.
Expected Outputs	1. Verify the following: *(The following data must be recorded and submitted to UKPN)* 2. kW – 'Active' power at the applicable measurement point 3. Kvar – 'Reactive' power at the applicable measurement point 4. Voltage at controlled busbar, usually the PoC 5. 'Voltage Setpoint' or 'Voltage Reference' 6. Time response of the DER control system 7. Initial reaction time to make a 'Reactive' power response to a change in 'Voltage' Setpoint 8. Total time taken to get a settled response
Test Environments	On-site (Note in on-site testing we may need to coordinate with customer to make sure all commands do not cause any operational safety issues)

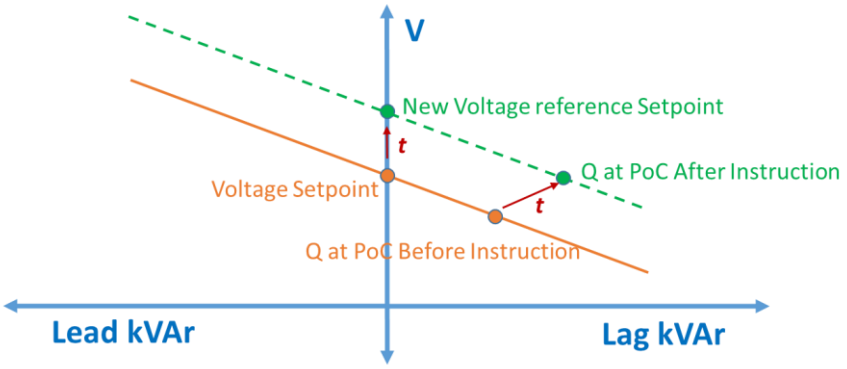


Figure 4 – Voltage response test

5.4 Active Power Capability Tests

Test case identifier	DER_Capability_Active_Power_1
Description	The capability is usually measured at the PoC to the network and applies to the DER rather than component parts. The 'Active' power testing is normally arranged with the 'UKPN control centre' at a mutually agreed time. The test will be carried out under instruction from the UKPN control engineer and should be monitored and recorded at both the 'UKPN control centre' and by the DER owner. This test will demonstrate the capability of the DER to curtail 100% (or the Maximum possible generation on the day of testing) and to export 100% (or Maximum possible generation on the day of testing) as instructed by the UKPN master system. *This is only applicable to DER participating in the Active power service.*
Pre-Requisites	1. RTU and DER control system are fully integrated and testing completed. 2. Local HMI are available for changing the different control conditions and getting the feedback.
Inputs/Outputs	*The outputs are listed below:* 1. Maximum DER Active power limit reached. 2. Minimum DER Active power limit reached.
Test Steps	1. Put the DER in 'Active' power mode. 2. From local HMI verify that DER is in 'Active' power mode. 3. Set 'Active' power upper and lower Limits and Setpoint at 100% (or the maximum available capacity on the day of testing). 4. From local HMI verify that DER is operating at 100% value of Active Power Setpoint and Limits. 5. Maintain status quo for 5 minutes. 6. Set 'Active' power upper and lower Limits, and Setpoint at 0%. 7. From local HMI verify that DER is operating at 0% value of 'Active' power Setpoint and Limits. 8. Maintain status quo for 5 minutes. 9. Switch back to original 'Active' power Setpoint. 10. Put the DER in 'Default' mode (as indicated in *"DER Framework Agreement and Connection Agreement"*).
Expected Outputs	Verify the following: 1. DER responds to 'Active' Power Limits and Setpoints. 2. Note the time response from setpoint change to the final value. 3. Note the Reactive power and PF (if applicable). 4. Note the connection point voltages.
Test Environments	On-site (Note in on-site testing we may need to coordinate with customer to make sure all commands do not cause any operational safety issues)

5.5 Active Power – Speed of Response

Test case identifier	DER_Capability_Active_Power_2
Description	These tests will examine the DER speed of response capability to achieving Active and Reactive power service instructions issued to the DER control system. The DER test results are expected to be consistent (where relevant) with the DER Framework Agreement, Schedule 3. This is only applicable to DER participating in the Active power service.
Pre-Requisites	1. RTU and DER control system are fully integrated and testing completed. 2. Local HMI are available for changing the different control conditions and getting the feedback. 3. Put the DER at as close as possible to 60% 'Active' power range, or other Active power range agreed with the DER consistent with capability offered in its framework agreement and current operating conditions.
Inputs/Outputs	*The outputs are listed below:* 1. The DER Active Power setpoint reached (MW/sec) according to DER Framework Agreement, Schedule 3 (see **Figure 5**). 2. The DER Voltage Power setpoint reached (sec) according to DER Framework Agreement, Schedule 3.
Test Steps	1. Put the DER in 'Active Power' mode. 2. From local HMI verify that DER is in 'Active' power mode. 3. Make a 'Active' power Setpoint change of say -5 % (or as close as possible). 4. Wait for the DER response to settle. 5. From Local HMI verify that DER is operating with requested 'Active' power Setpoint. 6. Make a 'Active' power Setpoint change of say +5 % (or as close as possible). 7. Wait for the DER response to settle. 8. From Local HMI verify that DER is operating with requested 'Active' power Setpoint.
Expected Outputs	1. Verify the following: *(The following data must be recorded and submitted to UKPN)* 2. kW – 'Active' power at the applicable measurement point. 3. Kvar – 'Reactive' power at the applicable measurement point. 4. Time response of the DER control system. 5. Initial reaction time to make an 'Active' power response to a change in 'Active' power Setpoint. 6. Total time taken to get a settled response.
Test Environments	On-site (Note in on-site testing we may need to coordinate with customer to make sure all commands do not cause any operational safety issues)

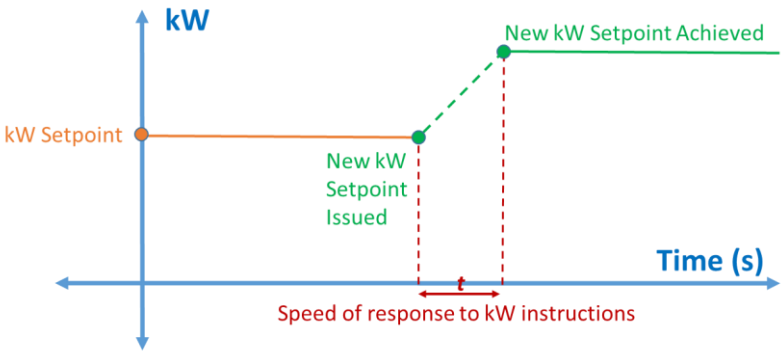


Figure 5 - MW response test

6. Definitions, Acronyms and Abbreviations

Term	Definition
AVC	Automatic Voltage Control (AVC)
DER	Distributed Energy Resources
DER control system	The native control system used by the DER customer to operate and control the DER plan that interfaces with the UK Power Networks equipment
DERMS	Distributed Energy Resources Management System The centralised software based control system within UK Power Networks that dispatches DER to provide active and/or reactive power services to National Grid ESO as part of the Power Potential project
DNP3	Distributed Network Protocol Communication protocol widely used with the utilities industry and used by UK Power Networks for its SCADA system
DNO	Distribution Network Operator
GSP	Grid Supply Point
HMI	Human Machine Interface (screen for operation)
NG ESO	National Grid Electricity System Operator
PAS	Platform for Ancillary Services (National Grid system)
PowerON	The end-to-end Network Management System that UK Power Networks is using at control centre level to manage its distribution network
PoC	Point of Connection The interface between the UK Power Networks' equipment (main fuse, energy meter) and the consumer's equipment (supply panel)
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition Centralised computer-based systems that monitor and control the electricity distribution network
UKPN	UK Power Networks

7. List of Referenced Documents

No	Document Title	Document Reference
[1]	DER Technical Requirements	https://www.nationalgrideso.com/innovation/projects/power-potential
[2]	DER Commissioning Test Procedure (includes commissioning test form)	Internal UK Power Networks _ ECP 11-0702 (draft)
[3]	DER Commissioning Test Requirements	Internal UK Power Networks _ ECP 11-0703 (draft)
[4]	Power Potential Test Strategy	PP-Test Strategy v0.10.doc (Internal UK Power Networks)
[5]	DER Interface Schedule	https://www.nationalgrideso.com/innovation/projects/power-potential

8. Appendices

The document below can be found in the UK Power Networks G81 design specification library

Appendix	Document Name
A	EDS 05-9600a RTU Logic for ANM schemes diagram

9. Document control

Version	Date	Author(s)	Reviewers	Summary of Change
1.0	02/11/2018	Dr Ali R Ahmadi Dr Sima Davarzani	Tim Manandhar Dr Rita Shaw	Creation of document
1.1	07/11/2018			Grammatical changes
1.2	12/11/2018		Kellie Dillon Dr Rita Shaw	Clarity to DER customers
1.2.1	13/11/2018		Kellie Dillon Dr Rita Shaw	Correct references from section 1 to 4, Watchdog signal removed, DNP3 poll remains.
1.2.2	22/11/2018		Dr Sima Davarzani Dr Rita Shaw	Minor changes
1.2.3	28/11/2018		Dr Rita Shaw	Change cover page
1.2.4	29/06/2020	Dr Sima Davarzani	Kellie Dillon Dr Rita Shaw Dr Ali R Ahmadi Tam Sokari-Briggs	Removed the I/O points and referred to the DER Interface Schedule document Minor changes through the document for clarity purposes to address DER's feedback

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