NIA ENWL013
Detection of Islands

Progress Report

31 July 2018

VERSION HISTORY

Version	Date	Author	Status	Comments
V1.0	13 April 2018	Geraldine Paterson Innovation Engineer	Final	

REVIEW

Name	Role	Date
Lucy Eyquem	Innovation PMO Manager	3 July 2018
Paul Turner	Innovation Manager	25 July 2018

APPROVAL

Name	Role	Date
Steve Cox	Engineering & Technical Director	31 July 2018

CONTENTS

1	PROJECT FUNDAMENTALS	5
2	PROJECT SCOPE	5
3	OBJECTIVES	5
4	SUCCESS CRITERIA	5
5	PERFORMANCE COMPARED TO THE ORIGINAL PROJECT AIMS, OBJECTIVES AND SUCCESS CRITERIA	5
6	REQUIRED MODIFICATIONS TO THE PLANNED APPROACH DURING THE COURSE OF THE PROJECT	7
7	LESSONS LEARNED FOR FUTURE PROJECTS	7
8	THE OUTCOME OF THE PROJECT	7
9	DATA ACCESS	7
10	FOREGROUND IPR	7
11	PLANNED IMPLEMENTATION	7
12	OTHER COMMENTS	7

GLOSSARY

Term	Description
ADMS	Advanced distribution management system
AVR	Automatic voltage regulator
DG	Distributed generator
DNO	Distribution network operator
IPR	Intellectual property rights
IPSA	Software tool developed specifically for power system design and operation applications
LOM	Loss of mains
NMS	Network management system
PowerFactory	Leading power system analysis software application for use in analysing generation, transmission, distribution and industrial systems
RoCoF	Rate of change of frequency
SCADA	Supervisory control and data acquisition

1 PROJECT FUNDAMENTALS

Title	Detection and prevention of formation of islands via SCADA
Project reference	NIA_ENWL013
Funding licensee(s)	Electricity North West Limited
Project start date	January 2016
Project duration	2 years 9 months
Nominated project contact	Geraldine Paterson (innovation@enwl.co.uk)

2 PROJECT SCOPE

The project is a proof of concept examination into the use of SCADA and ADMS as a solution to overcome the issue of island formation as a result of wider RoCoF settings.

3 OBJECTIVES

To produce a proof of concept paper and associated functional specification on the use of SCADA and ADMS to detect and fragment islands formed on the distribution network.

4 SUCCESS CRITERIA

This project will be considered a success upon production and publication of a proof of concept paper and associated functional specification on the use of SCADA and ADMS to detect and fragment islands formed on the distribution network. It is proposed that the outcomes of the project will be shared with industry experts and comments invited.

5 PERFORMANCE COMPARED TO THE ORIGINAL PROJECT AIMS, OBJECTIVES AND SUCCESS CRITERIA

5.1 Technical requirements for detecting an islanded network

Loss of mains (LOM) protection is normally installed on each distributed generator (DG) so that if the DG detects a loss of the network, it will disconnect and prevent the network it is connected to from being continuously energised. Islanded operation is avoided due to safety concerns and issues surrounding protection coordination. In addition DNOs have licence obligations to operate the network within the statutory limits such as voltage, frequency and power quality. In the case of islanded networks DNOs will likely have little to no visibility of the operational state of an island and no means of control. Therefore it is preferable to prevent such networks from forming.

A common technique employed for LOM protection devices is to measure the rate of change of frequency (ROCOF) and trip the DG if the ROCOF exceeds a predetermined threshold. A recent modification of the GB Distribution Code has altered the ROCOF setting which essentially desensitized the protection in order to reduce nuisance tripping caused by reduced overall system inertia. The new desensitized ROCOF settings will allow a greater proportion of DGs to remain connected to the network and therefore increase the probability of islands forming.

There are potential benefits to allowing the operation of islands. It can increase the reliability of the network and reduce supply interruptions. Critical loads can benefit from uninterrupted supply in the event of outages in the upstream utility supply. It can also assist with black start after the network has undergone a local, regional or national black out.

A key requirement for the formation of an islanded network is to have the generation and demand closely balanced. Once an island is formed, a sustained island can be detected by the presence of voltage and frequency in the isolated network. The voltage and frequency must be stable and operating within the statutory limits.

A network management system (NMS) has the functionality to detect the status of network switches and includes a tracing facility that can identify if part of a network is energised from a grid supply point. By correlating the information of switch statuses at strategic locations and the measurement of local network parameters such as voltage and frequency, the detection of an island can be achieved.

The current polling rate of the NMS with regards to the network state is in the range of seconds. However, a transient event that can lead to an islanded network being formed can take place in milliseconds which can lead to a delay in the detection of the island by the NMS. Hence, a review of the current polling rate is recommended to understand the change in the polling rate required to satisfactorily detect such islanded networks.

5.2 Sustaining an islanded network

Once detected the DNO then needs to decide whether it is acceptable to sustain the island. If it is deemed unacceptable for the network to be operated as an island then an inter-tripping scheme could be employed to ensure the island is shut down.

If it is acceptable to be operated as an island, the network switches that are associated with the potential island network should be monitored as well as the voltage and frequency of the island network. As frequency is currently not monitored in the distribution network, deploying frequency monitoring devices at strategic locations of a distribution network that have a high probability of forming an island should be explored.

Appropriate measures should then be employed to ensure a safe, stable and reliable operation of the islanded network. The control of the islanded network may either be local or central. There are many different schemes proposed for both local and centralised control of islanded networks. One example of local control is for all the DGs within the island to employ active and reactive power drop control schemes but this would entail contractual agreements between the DNO and DG owners to allow control of the system to be handed over to a third party.

An example of centralised control is a scheme in which one DG is designated as the slack source (master) capable of regulating the island frequency and voltage and the remaining DGs (slaves) outputting active and reactive power based on set points sent from an auxiliary control system which could be integrated with the NMS. For a centralised control scheme, the DNO is best placed to have the responsibility of forecasting the island demand and dispatching DGs.

When re-connecting to the grid after the fault is cleared, unsynchronised reclosing can result in damage to network assets and customer equipment, therefore, DGs must be controlled so that voltage magnitude, phase and frequency between the island and main grid are within the limits for synchronisation.

5.3 Modelling an islanded network

Modelling is being conducted on a section of the Electricity North West network to understand the impact of sustaining islands.

Our project partner, WSP, was provided with the IPSA model of the network downstream of Heysham grid supply point. This model was transferred to PowerFactory using bespoke software developed by WSP and further improved for this project.

Generation was added to the model to represent the existing and accepted generation which will be connected to the Heysham and Lancaster grids. Each existing generator required appropriate controller models and parameters to be set including AVR and governor for synchronous machines.

Analysis of the network has shown there is sufficient capacity to sustain an island system with a peak demand of 113MW.

The modelling work is still ongoing with results due in early autumn.

6 REQUIRED MODIFICATIONS TO THE PLANNED APPROACH DURING THE COURSE OF THE PROJECT

There have been no changes to the planned approach.

7 LESSONS LEARNED FOR FUTURE PROJECTS

No lessons have been identified at this stage of the project.

8 THE OUTCOME OF THE PROJECT

Not applicable.

9 DATA ACCESS

Electricity North West's innovation data sharing policy can be found on our website

There has been no data collected in the course of this project.

10 FOREGROUND IPR

There is no foreground IPR that has been developed by the project.

11 PLANNED IMPLEMENTATION

Not applicable.

12 OTHER COMMENTS

Not applicable