DISTRIBUTION RESTORATION ZONE CONTROL SYSTEM

HIGH LEVEL FUNCTIONAL REQUIREMENTS

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PURPOSE AND SCOPE

This document describes the high level functional and performance requirements of a Distribution Restoration Zone Control System which may be used by Network Operators to establish a Distribution Restoration Zone.

A Distribution Restoration Zone as defined in the Grid Code is a section of a Network Operator's System which following a Total System Shutdown or Partial System Shutdown is re-energised through instructions given by the Network Operator to an Anchor Generator. This process is used to energise sections of the Network Operator's System and feed local demand. Additional Demand and further sections of the Network Operator's System are then re-energised using Top Up Restoration Service Providers Plant and Apparatus until the Distribution Restoration Zone is connected to another Power Island formed from an adjacent Local Joint Restoration Plan or adjacent Distribution Restoration Zone. In some cases, where appropriate conditions permit, it is possible for a Distribution Restoration Zone to energise dead sections of the Transmission System.

The process of re-establishing the System following a Total System Shutdown or Partial System Shutdown in complex, requiring complex switching sequences and changes to protection and control settings. In addition, there is the need to have a secure, reliable and mains independent communications systems in order to control network assets and have visibility of the topology of the relevant sections of the Network Operator's System in real time.

Although not a mandatory requirement, any Network Operator which elects (in co-ordination with The Company and relevant Restoration Service Providers) to provide and make available a Distribution Restoration Zone, may choose to use a Distribution Restoration Control System which under the Grid Code is defined as "*A mains-independent automatic control and supervisory system which assesses the status and operational conditions of part of a Network Operator's System and where relevant, parts of the Transmission System for the purposes of operating Restoration Service Providers' Plant and/or modulating Restoration Service Providers' Demand in addition to operating items of the Network Operator's Plant and Apparatus and relevant Transmission Licensees Plant and Apparatus for the purposes of establishing and operating a Distribution Restoration Zone".*

This specification lists the high level features required of a Distribution Restoration Zone Control System if a Network Operator selects to install one. The requirements have been deliberately kept at a high level to provide sufficient flexibility for the Network Operator to address more detailed elements with their supplier.

PART 1 – FUNCTIONAL AND PERFORMANCE REQUIREMENTS

1 High Level Capability Requirements

Where a Network Operator elects to install a Distribution Restoration Control System as part of a Distribution Restoration Zone it is required to have the following key capabilities:-

- The Distribution Restoration Zone Control System shall be installed in a secure enclosed premises where the ambient conditions are controlled to prevent equipment damage – for example, excessive light, heat, temperature and humidity. A substation telecoms room or Network Operators Control Centre Apparatus Room would be considered appropriate for such an application.

- The Distribution Restoration Zone Control System shall be mains independent for at least 72 hours.
- All communications links and inputs/outputs to and from the Distribution Restoration Zone Control System including interfaces to DNO Control Centres including Energy Management Systems, status indications of switchgear, alarms, supervisory equipment and despatch instructions to Restoration Service Providers Plant and Apparatus shall be secure and mains independent.
- The entire Distribution Restoration Zone Control System shall be Cyber Secure in accordance with the Security of Network and Information System (NIS) Regulations.
- The Distribution Restoration Zone Control System shall be able to be configured and tested remotely from the Network Operator's Control Centre.
- All outputs and SCADA information from the Distribution Restoration Zone Control System shall be available to Network Operators Control Engineers via their Energy Management System or equivalent and shall include but not limited to operational metering signals, status indications, relevant topology and sequence of operation including the output and status of Restoration Service Providers Plant and Apparatus.
- The outputs and SCADA information of the Distributed Restoration Zone Control System including operational metering signals, status indications, relevant topology and sequence of operation including the output and status of Restoration Service Providers Plant and Apparatus shall be available to The Company and relevant Transmission Licensee (where relevant) through ICCP links or equivalent. The communications circuits to The Company and Relevant Transmission Licensee are to be duplicated with one line to The Company's and relevant Transmission Licensee's main Control Room and the backup to The Company's Backup and relevant Transmission Licensee's Backup Control Room.
- The power resilience of all communications circuits to and from the Distributed Restoration Zone Control System shall be in accordance with ENA Technical Specification G91. In addition all communications circuits to and from the Distribution Restoration Zone Control System shall be in accordance with EC-RGG which provides advice and guidance on agreed best practice in the establishment and maintenance of resilience within telecommunications networks and services, for those Communications Providers which are part of the UK's Critical National Infrastructure (CNI), either because of the scale of their operations or because they provide key services to other parts of the CNI.
- The Distributed Restoration Zone Control System communications links shall have sufficient latency so as not to impinge on the correct functioning of the Distribution Restoration Zone Plan.

PART 2 – PERFORMANCE REQUIREMENTS OF INDIVIDUAL ELEMENTS FORMING PART OF THE DISTRIBUTION RESTORATION ZONE CONTROL SYSTEM

2.1 Communication Links to the ESO

Where a Distribution Restoration Zone Control System is installed by a Network Operator, Inter-Control Centre Communications protocol (ICCP) links or equivalent are required to provide real time situational awareness of the Distribution Restoration Zone to the ESO control room. This will enable the ESO to provide overall coordination of the wider restoration process. The ICCP link or equivalent will connect the DNO's Distribution Restoration Control System to the ESO's energy management systems. These systems are usually within the control centres. The design and functional specification of the ICCP link or equivalent will be coordinated between the ESO and the DNO.

The diagram below illustrates the components and communication interfaces of the Distribution Restoration Zone Control System.

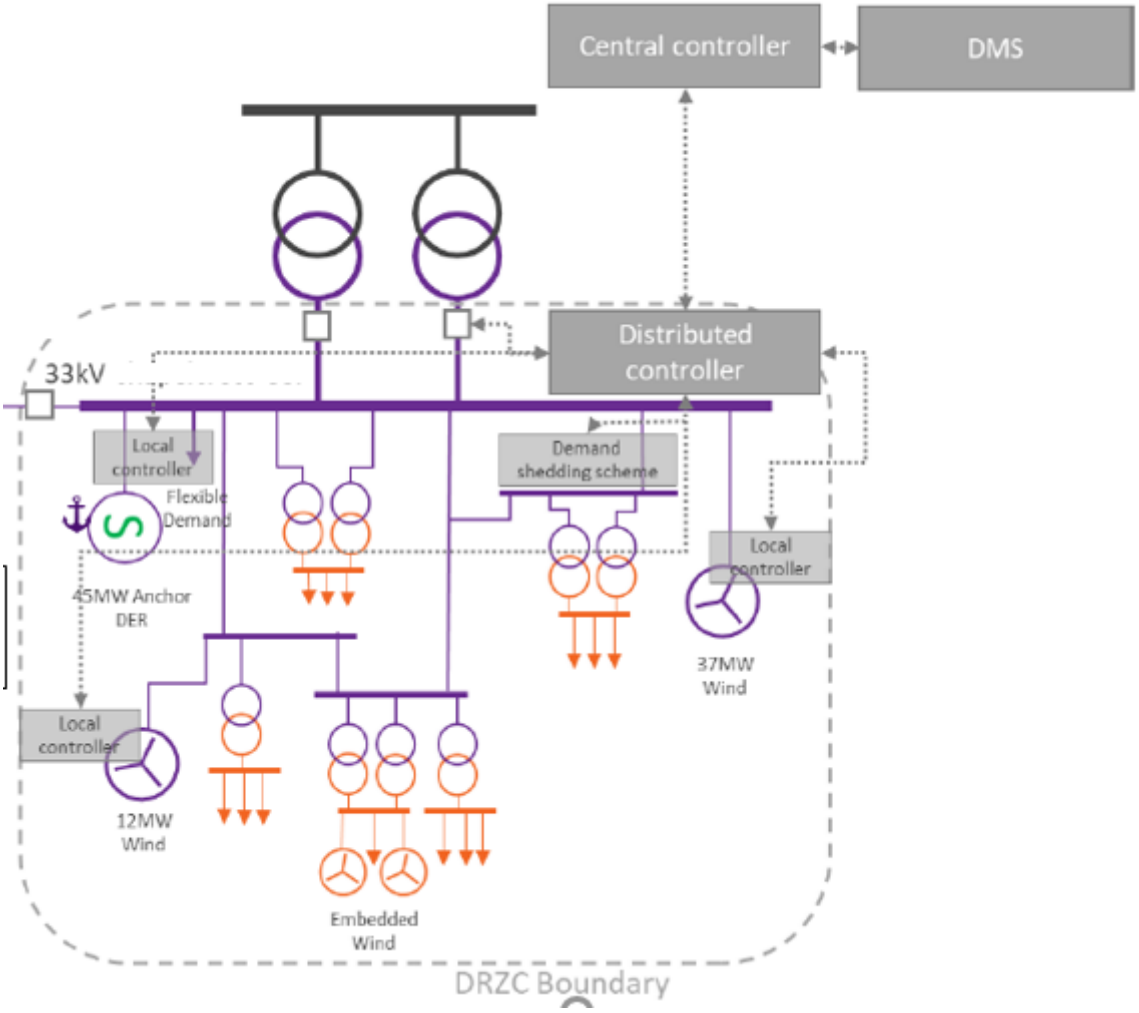

Figure 1: DRZC Schematics

2.2 Distribution Restoration Zone Controller Interfaces

Where a Distribution Restoration Zone Control System is installed, there is a requirement for a new interface between the Distribution Restoration Zone Control System and the Remote Terminal Unit (RTU) of both the anchor generators and top up service providers Plant and Apparatus. The DRZC could comprise a central controller and one or more distributed local controllers depending on the architecture of the Distribution Restoration Zones within the DNO's system. The interface from the

local controller to the Distributed Energy Resources (DERs) will need to be defined on a case by case basis.

2.3 Distribution Restoration Zone Control System Technical Characteristics

The following requirements will be determined when deploying the Distributed Restoration Zone Controller (DRZC). It is acknowledged that these could vary depending on the specific implementation of the DRZC as the DNOs will be individually implementing it. These requirements will need to be resolved when the DNO procures the DRZC from its nominated supplier.

1. Latency

   The end-to-end communication paths shall have minimum delay.

2. Resilience

   Any circuits within an IP network shall be configured for the highest level of guaranteed quality of service.

3. Bandwidth

   bandwidth required for end-to-end traffic management.

4. Protocol support

   List of protocols supported for the end-to-end deployment of the DRZC

5. Circuit path separation / redundancy

   In general, it will be appropriate to have only a single communication path to the Restoration Service Providers site/assets. In some cases, there is an elevated risk of interrupted communication, or a specific business as usual (as opposed to Restoration Service) needs, a second separate path may be appropriate, but the number of separate communication paths should never outnumber the number of independent electrical circuits connecting the site/assets to the wider network

6. Support and maintenance arrangement

   The DNO will be responsible for the installation and ongoing maintenance of this communication path.

7. Cyber security

   The DNO shall be responsible for ensuring the data is secure and meeting legal and Network and Information Security (NIS) Directive requirements.

8. Physical security
   a. The DNO will be responsible for installing the communications path up to the RTU and the cable(s) shall be suitably protected against physical damage.
   b. The DER shall be responsible for ensuring the cable(s) is suitably protected within their equipment.
9. Power resilience
   a. The circuit will have the minimum power resilience end to end as required in ER G91.
   b. The DNO will have responsibility for ensuring the design meets the criteria.
   c. The DER owner shall be responsible for ensuring and demonstrating equivalent power resilience on all the equipment necessary to operate the DER in accordance with the Distribution Restoration Zone Plan (DRZP).
10. Testing /Assurance
    a. The DNO shall be responsible for testing the communications path as specified in the Assurance process in accordance with Grid Code OC5.7.4.
    b. The DER owner and DNO shall monitor the health of the DRZC and provide technical support in the event of a fault situation.

The above requirements as applicable to the various elements of a Distributed Restoration Zone Controller are detailed in Annex 1 of this document.

PART 3 – DEFINITIONS AND DOCUMENT HISTORY

3 DEFINITIONS AND ABBREVIATIONS

CNI	Critical National Infrastructure
DER	Distributed Energy Resources
DMS	Distribution Management System
DNO	Distribution Network Operator
DRZC	Distribution Restoration Zone Control System
DRZP	Distribution Restoration Zone Plan
ER G91	Engineering Recommendation G91 – Substation Black Start Resilience
ICCP	Inter-Control Centre Communication Protocol
NIS	Network and Information Security
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition

PART 4 – AMENDMENTS

4 AMENDMENTS RECORDS

Issue	Date	Summary of Changes/Reasons	Author(s)	Approved by (Inc Job Title)

4.1 Procedure Review Date

3 years from publication date

PART 5 - GUIDANCE NOTES AND APPENDICES

5 REFERENCES

BS EN 61850	Communication networks and systems for power utility automation.
EC-RRG	Resilience Guidelines for Providers of Critical National Telecommunications Infrastructure
ITU-T G Series	International Telecommunication Union standard where applicable
IEC60870-5-101	Telecontrol Equipment and Systems – Part 5-101: Transmission Protocols – Companion Standard for basic Telecontrol Tasks
IEC60870-5-104	Telecontrol Equipment and Systems – Part 5-104: Transmission Protocols – Network Access for IEC60870-5-101 using Standard Transport Profiles
IEC 62351	The IEC 62351 series of standards include cyber security technologies for some communication protocols specifically: IEC 60870-5 protocols (including IEEE 1815 (DNP3) as a derivative standard),

	IEC 60870-6 (ICCP).
	IEC 61850 protocols (including client-server, GOOSE, and sample values).
	IEC 61970 and IEC 61968 (Common Information Model – CIM).
IEC 62443	Requirements and processes for implementing and maintaining electronically secure industrial automation and control systems (IACS).

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ANNEX 1

A-End	B-End	Name / ident	Protocol	Medium	Bandwidth	Latency	Encryption	Physical interface	Comments
Local Controller (LC)	RTU / DER Control interface (R1)	LC R1	TBC	Copper / fibre	TBC	TBC	TBC	TBC	This will be a hard-wired cable running between the local controller and RTU. The technical specifications of the medium will be finalised once the system parameters have been defined by the control system design authority.
Local Controller (LC)	Distributed Controller (DC)	LCA DC	TBC	fibre	TBC	TBC	TBC	TBC	This will be a circuit carrying data between the local controller and distributed zone controller. It can be made up of several hops, but the end-to-end characteristics shall be such to meet the specified technical system requirements once defined by the control system design authority.
Distributed Controller (DC)	Central Controller (CC)	DC CC	TBC	fibre	TBC	TBC	TBC	TBC	This will be a circuit carrying data between the Distributed Zone controller and the central controller of the DNO. It can be made up of several hops, but the end-to-end characteristics shall be such to meet the specified technical system requirements once defined by the control system design authority.

A-End	B-End	Name / ident	Protocol	Medium	Bandwidth	Latency	Encryption	Physical interface	Comments
Central Controller (CC)	DNO DMS (DD)	CC DD	TBC	Copper / fibre Layer 1	TBC	TBC	TBC	TBC	This will be a hard-wired connection between the central controller and local DNO DMS system. It is anticipated this will be co-located within the DNO control centre and will be defined by the control system design authority.
DNO DMS (DD)	ESO DMS (ED)	DD ED (ICCP)	ICCP	OpTel Fibre	TBC	TBC	TBC	TBC	This will be a circuit carrying data between the DNO DMS System and ESO control centre. The function is to provide the ESO with visibility of the DNO network. The circuit can be made up of several hops, but the end-to-end characteristics shall be such as defined by the control system design authority.