

## **SUBSTATION INTERLOCKING SCHEMES**

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### **PURPOSE AND SCOPE**

This document describes the technical requirements of interlocking schemes for User's equipment directly connected to the England and Wales Transmission system and located within NGET's busbar protection zone operating at nominal voltages of 400 kV, 275 kV, 132 kV and 66 kV unless otherwise agreed with the user as defined in the Bilateral agreement. The principles of this document apply to equipment connected at other voltages.

### **PART 1 – TECHNICAL REQUIREMENTS**

#### **1 GENERAL REQUIREMENTS**

##### **1.1 Common Requirements**

- 1.1.1 So that operators do not compromise the integrity of the Transmission System in England and Wales by incorrect or inadvertent operation of equipment, substations shall be provided with a full interlocking scheme to ensure that all disconnectors, fixed earthing switches (or other interlocked earthing devices) and where required circuit-breakers, are operated in the correct sequence.
- 1.1.2 In substations where NGET is a joint occupier and/or has operational responsibility for switchgear then the interlocking shall also be designed with consideration of personnel safety.
- 1.1.3 Interlocking schemes shall cover the following conditions:-
- (a) Interlocking between circuit breakers and disconnectors to ensure disconnectors do not operate outside their rating i.e. make or break load currents.
  - (b) Interlocking between disconnectors and earthing switches to ensure that earthing switches cannot be closed on to a locally energised circuit and cannot be energised, when closed, by operation of disconnectors.

- (c) Interlocking between disconnectors and adjacent earthing switches to permit operation of the disconnector when earthing switches are closed on both sides of the disconnector. Such interlocking is not required for equipment rated at 145kV and below.
  - (d) To ensure correct sequence of on load busbar transfer switching operations at multiple busbar substations.
  - (e) To ensure that a bus-coupler or bus-section circuit breaker is only closed with its associated disconnectors are both open or both closed.
  - (f) For equipment at sites where NGET is the Occupier, to restrict access to areas of the substation where safety clearances may be infringed unless appropriate safety measures, such as isolation and earthing, have been taken.
- 1.1.4 The interlocking of switching sequences involving only power operated switchgear shall be by electrical means. The correct interlocking status shall be confirmed automatically on initiation of an operation from any control position or from auto-switching or sequential-isolation equipment.
- 1.1.5 The interlocking of switching sequences involving manually operated switchgear may be by electrical or mechanical means. The interlocking shall be designed such that the correct interlocking status must be confirmed immediately before an operation.
- 1.1.6 Interlocking systems shall, where reasonably practicable, be fail-safe. They shall not be defeated without the use of tools, clip leads etc. or a purpose designed override facility.
- 1.1.7 Interlock override facilities shall be lockable with a unique lock or shall be lockable by means of a safety padlock.
- 1.1.8 Partial interlocking of earthing switches at circuit-entries to the substation is acceptable where it is not reasonably practicable to extend the interlocking to the remote end disconnectors. Any partially interlocked earthing switch shall be provided with a warning label stating 'WARNING, THIS EARTHING SWITCH IS NOT FULLY INTERLOCKED'.
- 1.1.9 Interlocking shall be effective for switching and operating sequences when they are being followed in either direction (for example; if an earthing switch must be closed before an access gate can be opened then the gate must be secured closed before the earthing switch can be opened).
- 1.1.10 Interlocking schemes shall, where reasonably practicable, provide the maximum operational flexibility and shall not unnecessarily impose fixed operating sequences.
- 1.1.11 Where an interlocking scheme is being supplied for an extension to an existing substation at the same operating voltage then, unless otherwise agreed by NGET, the interlocking philosophy shall match that existing.
- 1.1.12 Interlocking for a substation extension shall be fully interfaced with the existing interlocking scheme to achieve the functional requirements specified in this document.
- 1.1.13 Interlocking may, in certain circumstances, have to be by-passed by auto-reclose schemes. The requirements for these are specified in TS 3.24.16. (RES).
- 1.2 Mechanical Interlocking**
- 1.2.1 Mechanical interlocking systems shall be designed to provide a level of security and reliability comparable with equipment specified in Clauses 1.2.2 to 1.2.6 below.
- 1.2.2 Mechanical interlocking shall be by key operated systems

- 1.2.3 Interlock keys shall be of a non-masterable design (i.e. no master key can be supplied or manufactured). Differs shall not be repeated on the same substation site.

*Note: Differ is the term for the difference in a key which prevents it being interchangeable with another.*

- 1.2.4 Interlock keys shall be engraved with an identifying reference which shall be unique to that substation site. The identifier shall, where appropriate, include the system number of the switching device where the key is located during normal operation. Key locations shall be marked with the identifier of the required key.

- 1.2.5 Where key exchange boxes are provided they shall be located in convenient positions with regard to normal substation operating sequences.

- 1.2.6 Where mechanical key interlocking is fitted to disconnecter and earthing switch mechanisms the requirements specified in TS 3.2.2 (RES) shall apply.

### **1.3 Electrical Interlocking**

- 1.3.1 Electrical interlocking systems shall be designed to provide a level of security and reliability comparable with equipment specified in Clauses 1.3.2 and 1.3.3 below.

- 1.3.2 A facility shall be provided to allow the interlock system of each disconnecter or earthing switch to be defeated without disturbing wiring. The facility shall meet the requirements of Clause 1.1.7 above.

*Note This may take the form of a self-resetting switch or push-button to bypass electrical circuits.*

- 1.3.3 Disconnecter and earthing switch mechanisms which form part of electrical interlocking schemes shall meet the requirements of TS 3.2.2 (RES).

## **2 PERFORMANCE REQUIREMENTS**

Mechanical and hard-wired electrical interlocking schemes shall operate satisfactorily under the full range of environmental conditions specified for the associated primary equipment.

## **3 FORMS AND RECORDS**

None.

## **PART 2 - DEFINITIONS AND DOCUMENT HISTORY**

### **4 DEFINITIONS**

None.

## 5 AMENDMENTS RECORD

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	February 2018.	New document	Andrew Ridley Policy Development	

## 6 IMPLEMENTATION

### 6.1 Audience Awareness

Audience	Purpose Compliance (C) / Awareness (A)	Notification Method Memo / letter / fax / email / team brief / other (specify)
N/A		

### 6.2 Training Requirements

Training Needs N/A / Informal / Workshop / Formal Course	Training Target Date	Implementation Manager
N/A		

### 6.3 Compliance

N/A

### 6.4 Procedure Review Date

5 years from publication date.

## PART 3 - GUIDANCE NOTES AND APPENDICES

## 7 REFERENCES

The following TS (RES) documents are relevant to Substation Interlocking and should be read in conjunction with this document as appropriate.

- TS 1 (RES) Ratings and general requirements for plant, equipment, apparatus and services for the National Grid System and connection points to it.
- TS 2.1 (RES) Substations.
- TS3.2.2 (RES) Disconnectors and Earthing Switches

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