

## **RATINGS AND GENERAL REQUIREMENTS FOR PLANT, EQUIPMENT AND APPARATUS DIRECTLY CONNECTED TO THE NATIONAL GRID SYSTEM**

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### **PURPOSE AND SCOPE**

This document describes the technical requirements for Users' 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.

Requirements contained herein may be modified on a more specific basis by lower level specifications. Ratings are specified explicitly for plant with nominal voltages of 66kV and above. Derogation from the requirements of the RES will normally be permitted only where it can be demonstrated that the proposed derogation is not detrimental to the safety, reliability and availability of the Transmission System in England and Wales.

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

#### **1 ENVIRONMENTAL SERVICE CONDITIONS**

##### **1.1 General**

Plant, equipment and apparatus shall be suitable for operation under the normal service conditions defined in IEC 61936-1 with the following additions/modifications.

Equipment housed outdoors in association with high voltage plant shall have a degree of protection of at least IP54 as defined in BS EN 60529.

##### **1.2 Normal Service Conditions**

###### **1.2.1 Indoor**

The temperature class shall be “-5 indoor”.

###### **1.2.2 Outdoor**

The temperature class shall be “-25 outdoor”.

The ice coating classification shall be “class 10” (10mm).

The environmental pollution level shall be “Class III – Heavy” as defined in Table 1 of 60071-2.

## 2 ELECTRICAL REQUIREMENTS

### 2.1 System Voltage

Plant and Equipment shall satisfy their specified functional and performance requirements over the appropriate range of primary voltages given in Table 1.

Plant and equipment for use on the 400kV system shall also operate safely and without any degradation in performance when operated in the range 420kV to 440kV for not longer than 15 minutes.

Plant and equipment shall satisfy their specified functional and performance requirements with phase voltage unbalance up to a maximum of 1.5% for voltages above 150kV and up to a maximum of 2% for voltage of 150kV and below. Plant and equipment shall satisfy their specified functional and performance requirements when exposed to harmonic distortion levels in the voltage waveform up to the compatibility levels specified in Appendix A of ER G5/4.

Nominal System voltage	400 kV	275 kV	132 kV	66kV
Rated voltage of plant	420 kV	300 kV	145 kV	72.5kV
Maximum continuous System voltage	420 kV	303 kV	145 kV	70kV
Minimum continuous System voltage	360 kV	247 kV	119 kV	62kV

**Table 1 - System Voltage**

### 2.2 Rated Insulation Level and Protective Gap Settings

Plant shall meet the requirements of Table 3 with regard to its rated insulation level.

Table 4 details protective gap settings commonly used by National Grid which should be taken into account.

### 2.3 System Frequency

Plant and Equipment shall satisfy their specified functional and performance requirements over the range of frequencies given in Table 2.

Plant and equipment shall also operate safely and without any degradation in performance within the following frequency ranges:

Frequency Range	Duration
51.5Hz - 52Hz	15 minutes
51Hz - 51.5Hz	90 minutes
49.0Hz - 51Hz	Continuous
47.5Hz - 49.0Hz	90 minutes
47Hz - 47.5Hz	20 seconds

**Table 2 - System Frequency**

Nominal voltage (kV)	Rated voltage (kV)	Rated short-duration power frequency withstand voltage (kV)		Rated switching impulse withstand voltage (kV.pk)			Rated lightning impulse switching withstand voltage (kV.pk)	
		Common value*/ Phase to earth & between phases	Across open switching device and/or isolating distance	Phase to earth	Between phases	Across open switching device and/ or isolating distance	Common value*/ Phase to earth & between phases	Across open switching device and/ or isolating distance
400	420	520	610	1050	1575	900 (+345)	1425	1425 (+240)
275	300	380	425	850	1275	700 (+245)	1050	1050 (+170)
132	145	275*	315	N/A	N/A	N/A	650*	750
66	72.5	140*	160	N/A	N/A	N/A	325*	375
13 (tertiary)	17.5	38*	45	N/A	N/A	N/A	95*	110

**Table 3 - Insulation Level Requirements**

Nominal voltage (kV)	Mid-line overhead line arcing gap setting (m)	Substation approach (1.6km) overhead line arcing gap setting (m)	Transformer & reactor screened co-ordinating gaps (m)	Cable sealing end co-ordinating gaps (m)	Unscreened gaps applied to existing transformers/ reactors (m)
400	2.8	2.5	1.5	2.54	1.68
275	2.13	1.9	1.2	1.9	1.22
132	1.1	1	0.66	1	0.66
66	N/A	N/A	N/A	0.54	0.54
13 (tertiary)	N/A	N/A	0.1	0.1	N/A

**Table 4 - Arcing & Co-ordinating Gap Settings**

## 2.4 Earthing of System Neutral

Plant and Equipment shall satisfy their specified functional and performance requirements under the neutral earthing condition given in Table 5.

Nominal Voltage (kV)	Maximum Earth Fault Factor	Earthing Type
400, 275, and 132	1.4	Multiple direct
66	Site specific	Site specific impedance earthing
13 (tertiary)	Site specific	Site specific

**Table 5 - Neutral earthing**

## 2.5 Fault clearance time

Plant and Equipment shall be suitable for operation under the conditions detailed in Table 6.

Nominal Voltage(kV)	Target fault interruption time of main in-feeding circuit (ms)	Target total fault clearance time (all infeeds) (ms)	Target back-up clearance time (ms)
400	80	140	500 (1000*)
275	100	160	500 (1000*)
132	120	N/A	<1500
66	120	N/A	<1500
13 (tertiary)	75 (of which 35ms max' protection time)	N/A	N/A

**Table 6 - Target fault clearance requirements**

*\*Informative: Fault clearance times for zone 3 distance protection and residual earth fault protection on feeder circuits of 1 second are acceptable.*

In the event of a circuit-breaker failure, circuit-breaker fail protection shall trip all necessary contiguous circuit-breakers which are capable of supplying a fault infeed within a target fault clearance time not exceeding 300 ms.

## 2.6 Primary Currents

User's Plant & Equipment shall be rated such that it is fit for the intended purpose. Table 7 details National Grid standard primary currents rating for advisory purposes.

Fault withstand durations detailed in Table 7 are mandatory for Users' Plant and Equipment.

<b>System Voltage</b>	<b>Normal Current</b>	<b>Short-circuit Current</b>	<b>Duration of short-circuit</b>	<b>DC Time Constant</b>
<b>kV</b>	<b>A</b>	<b>(3- and 1-phase) kA</b>	<b>s</b>	<b>ms</b>
400	4000	63	1	45
275	3150	40	1	45
132*	2000	40	3	45
		31.5	3	135
66	2000	31.5	3	135
13	4000	50	1	96

**Table 7 - Short-circuit and load current requirements**

**3 DESIGN REQUIREMENTS**

**4 OPERATIONAL, MAINTENANCE AND MONITORING REQUIREMENTS**

**4.1 Multi-pole Opening/Tripping and Auto-reclosing**

Plant and equipment shall be suitable for operation under the following circuit-breaker operating conditions:

- a) Simultaneous three-phase opening/tripping.
- b) Simultaneous three-phase auto-reclosing on overhead line feeder circuits.

**5 SAFETY, HEALTH, ENVIRONMENT AND SECURITY REQUIREMENTS**

Users' Plant and Equipment installed on National Grid property shall comply with all relevant UK Health and Safety and Environmental legislation.

The National Grid system, in its entirety, complies with the Electromagnetic Compatibility (EMC) Directive (Statutory Instrument No. 2372 'The Electromagnetic Compatibility Regulations 1992') i.e. it is designed and constructed such that it does not introduce intolerable electromagnetic disturbances to its environment and is immune to electromagnetic disturbances in its environment. Users' Plant and Equipment which is directly connected to this system shall not detrimentally affect this compliance.

**5.1.1 Date Proofing**

Users' Plant and Equipment shall be immune to failure or malfunction due to the presence of date sensitive elements.

**6 FORMS AND RECORDS**

None.

**PART 2 - DEFINITIONS AND DOCUMENT HISTORY**

**7 DEFINITIONS**

**7.1 Directly (Connected)**

Connected in such a way that performance of the connected equipment directly affects the performance of the National Grid System. This is limited to equipment within the coverage of National Grid busbar protection.

**7.2 Plant**

Primary (high voltage) elements of the National Grid System such as the circuit-breakers, transformers, overhead lines and cables.

**7.3 Equipment**

Secondary (low voltage) elements of the National Grid System such as those for control, measurements, protection and auxiliary supplies.

**7.4 Apparatus**

Physical components of, or associated with, the National Grid System which are required in support of the plant and equipment. Examples are substation structures, auxiliary plant and portable test equipment.

**8 AMENDMENTS RECORD**

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
	October 2014	Issued in draft		
1	May 2018	New document	Mark Waldron	Grid Code Review Panel

**8.1 Procedure Review Date**

5 years from publication date.

**PART 3 - GUIDANCE NOTES AND APPENDICES**

**9 REFERENCES**

BS EN 60071	Insulation co-ordination
BS EN 60529	Degrees of protection provided by enclosures (IP Code)
BS EN 60654-1	Industrial – Process Measurement and Control Equipment Operating Conditions; Part 1 Climatic Conditions
IEC 61936-1	Power installations exceeding 1kV : Common rules
Engineering Recommendation (ER) G5/4	Levels of harmonic distortion
National Grid Safety Rules	

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