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National Grid
Technical
Specification

NGTS 1
Issue 3
March 1999

**Ratings and General
Requirements for Plant,
Equipment, Apparatus
and Services for the
National Grid System and
Connection Points to it**

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8 The National Grid Company plc 1999

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RATINGS AND GENERAL REQUIREMENTS FOR PLANT, EQUIPMENT, APPARATUS AND SERVICES FOR THE NATIONAL GRID SYSTEM AND CONNECTION POINTS TO IT

FOREWORD

This document is the highest level in a tier of 3 levels of documentation, each successive level providing more detail in a specific discipline. This document, in conjunction with the appropriate Level 2 and Level 3 specifications, collectively defines The National Grid Company plc=s (NGC) technical requirements for plant, equipment, apparatus and services for use on, and where appropriate for direct connection by Other User(s) to, its Transmission System. Such Other Users are defined in Clause 2.3.

Level 2 specifications cover different disciplines (eg 2.2 Switchgear, etc). Level 3 specifications provide requirements for specific plant, equipment, apparatus and service types relating to the general Level 2 disciplines (eg NGTS 3.2.1 covers circuit-breakers and shall be used in conjunction with NGTS 2.2 and NGTS 1).

The NGC Transmission System (NGC System) operating characteristics are detailed in [Cl 101 A Technical](#) and Operational Characteristics of the NGC Transmission [System@](#). Suppliers of plant, equipment, apparatus and services for use on the NGC System by NGC, and Other User(s) of the NGC System, should be aware of this document.

1 SCOPE

1.1 Scope Applicable to Suppliers of Plant, Equipment, Apparatus and Services to NGC

This document relates to the NGC System, operating at a nominal voltage of 132 kV and above. In addition, it relates to the specific 13 kV [transformer-tertiary](#) connected sub-systems. As the NGC demand for plant, equipment and apparatus at other system voltages below 132 kV is small, the requirements will be defined in the appropriate Contract [Enquiry](#) Document. Such requirements will not be less than those of the relevant IEC Standards.

This document defines the ratings and general requirements for plant, equipment, apparatus and services to be connected to the NGC System as detailed above, [by NGC itself](#), taking due consideration of the NGC System characteristics, as detailed in [Cl 101](#), and [the conditions](#) under which these products must operate safely and correctly. The detail of these ratings may be expanded upon in the appropriate Level 2 or Level 3 specifications. Where a choice exists within the NGTS specifications, the Contract Enquiry Document will identify the actual rating required.

In general, ratings are selected from the range of values given in the appropriate IEC documentation. Where this is not the case the rating relates to the particular requirements of the NGC network configurations, including its connected plant, equipment, apparatus and services.

G 1.2 Scope Applicable to Other Users

Other Users, as defined in Clause 2.3, connecting to the NGC System, shall [preferably](#) utilise the rating values or general requirements chosen by NGC for its own use, as indicated in Clause 1.1 of this document.

With NGC agreement, an alternative value or arrangement may be specified [on a site specific basis](#), preferably an IEC value or design arrangement, which is demonstrably compatible with the level of safety and security [required](#) by NGC for the NGC System as a whole.

Note: Such compatibility is achieved for normal current ratings by selecting the IEC matching value, or the next more severe IEC value, appropriate to the highest calculated conditions on the Other User=s directly connecting circuit. This value may not be that selected by NGC for its own system requirements at that location. Such calculated values shall take full account of the characteristics, electrical and physical, of the connection location.

G 1.3 Scope with Respect to the General Requirements for Plant, Equipment, Apparatus and Services

The environmental conditions experienced by plant, equipment, apparatus and services will vary across the system but for specification and NGC Type Registration purposes the general requirements detailed in the NGTS suite of documents, and all values specified within them, eg voltage, shall be related to the Normal or Special Service Conditions detailed in Clause 3 of this specification as amended, by agreement with NGC, by any specific application or location effects. Other Users should satisfy clause 1.2 where NGC Type Registration is not sought.

2 REFERENCES AND DEFINITIONS

G 2.1 This document should be read in conjunction with the following relevant documents:

UK Statutes and Regulatory Documents

The Grid Code
The Health and Safety at Work etc Act 1974
The Electricity at Work Regulations 1989
The Electricity Supply Regulations (1988) and Amendments (1990, 1994)
The Pressure Systems and Transportable Gas Containers Regulations 1989
The Construction (Design and Management) Regulations 1994

Note: The above list of statutes is not exhaustive, and may be updated by subsequent legislation. Where this is the case, the legislation applicable at the time of NGC Type Registration (clause 9) shall apply unless separately specified at the time of purchase or Supplemental Agreement, as appropriate. Suppliers should note that those listed are not the only statutes to which they are required to work.

NGC Commercial and System Strategy Documents

CI 101 - Technical and Operational Characteristics of the NGC Transmission System

NGTS Level 2 Specifications

The following are the suite of NGTS Level 2 specifications and they should be read in conjunction with this document as appropriate.

NGTS 2.1	Substations
NGTS 2.2	Switchgear
NGTS 2.3	Transformers
NGTS 2.4	Overhead Lines
NGTS 2.5	Cables
NGTS 2.6	Protection
NGTS 2.7	Substation Control Systems
NGTS 2.8	Telecommunications
NGTS 2.9	Measurements
NGTS 2.10	Civil
NGTS 2.11	High Speed Variable Static Var Compensators
NGTS 2.12	Auxiliary Supplies
NGTS 2.13	Electronic Equipment
NGTS 2.14	Compensation. D.C. Systems
NGTS 2.15	Automatic Switching
NGTS 2.16	Quality Assurance

NGTS 2.17	Equipment for Live Working
NGTS 2.18	>Relocatable= Variable Static Var Compensators (RSVCs) for Connection to Transformer Tertiary Windings
NGTS 2.19	Ancillary Light Current Equipment
NGTS 2.20	Oil Containment at Substations
NGTS 2.21	400 kV and 275 kV Mechanically Switched Capacitor Banks

NGTS Level 3 Specifications

As detailed in the appropriate Level 2 Specifications.

G 2.2 Documents Referred to in the Text:

The issue date of the following is that current at the date of issue of this NGTS 1 unless otherwise stated.

2.2.1 Electricity Association documents:

Engineering Recommendation G 5/3 Limits for Harmonics in the UK Electricity Supply System.

2.2.2 IEC and BSEN documents:

IEC 50	International Electrotechnical Vocabulary (IEV).
IEC 59	IEC standard current ratings.
IEC815	Guide for the selection of insulators in respect of polluted conditions.
<u>BSEN 60060</u>	<u>High-voltage test techniques.</u>
BSEN 60068 -2	Environmental Testing.
<u>BSEN 60071</u>	<u>Insulation co-ordination.</u>
BSEN 60255	Electrical relays.
BSEN 60529	Degrees of protection provided by enclosures (IP Code).
<u>BSEN 60654-1</u>	<u>Industrial - Process Measurement and Control Equipment Operating Conditions: Part 1 Climatic Conditions.</u>
<u>BSEN 60694 (IEC 694)</u>	<u>Common specifications for high-voltage switchgear and controlgear standards.</u>
BSEN 9000 - 1	Quality Management and Quality Assurance Standards.
<u>BSEN 9001</u>	<u>Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing.</u>
BS ISO 9000 - 2	Generic Guidelines for the Application of ISO 9001 etc.
<u>BS923</u>	

G 2.3 Definitions of Non-IEC Terms Used in this and Other NGTS Documents

For the purposes of this document and others in the NGTS suite of documents the following shall apply:

Supplier A manufacturer, or other organisation, supplying plant, equipment, apparatus or services for use on the NGC System or directly connected to it.

Direct Connection All Plant and Apparatus which is connected at the voltage of the User/NGC Connection Point and which is contained in equipment bays that are within the NGC busbar zone at the User/NGC Connection Point.

Other User(s) For the purposes of this suite of NGTS documents, an organisation, other than NGC, using the NGC System for the direct connection of generation, distribution, or load in compliance with The Grid Code.

*Note: This definition enables the Grid Code term **User** of the NGC system to be partitioned to identify NGC itself as a User, and all Other Users as a group.*

Contract [Enquiry](#) Document The commercial requirement document of NGC for a specific application.

Supplemental Agreement A Grid Code term repeated here for clarity: An agreement made pursuant to the Master Connection and Use of System Agreement to be entered into between NGC and a User {*Other User - see above*} covering a Connection Site.

[G](#) Sub-clauses required to be satisfied to gain NGC Type Registration status Category G (see clause 9) are marked G. Other Users are required to show that products (see below) for direct connection points (see above) are compliant with these clauses.

As such clauses are only relevant to the Connection Point they are normally only related to Switchgear products. The required G clause is used in those NGTS documents relevant to the Grid Code Direct Connection products. These documents are identified in the NGC Index of NGTS documents.

It is possible for such clauses to be specifically excluded from the requirements at a particular connection site as part of the Supplemental Agreement.

Clauses specifically applicable to Other Users are normally identified as such in the title to the clause/sub-clause.

All sub-clauses marked **G** are relevant to NGC Type Registration Category G (see Clause 9).

The absence of this marking indicates clauses required by NGC alone.

Product Used in this document as a collective term for plant, equipment, apparatus and services.

Plant and Equipment As there are no definitions for these descriptors in the IEC International Electrotechnical Vocabulary (IEC50 - IEV), they shall be taken jointly to mean all physical elements of the NGC System, HV and LV.

Plant shall be taken to relate to the primary elements such as the circuit-breakers, transformers, overhead lines and cables.

Equipment shall be taken to relate to the secondary elements such as those for control, measurements, protection and auxiliary supplies.

Apparatus This is a more general term than plant and equipment. It is used for the other physical components of the NGC System which support the plant and equipment, its application or testing. Such apparatus would include substation structures, auxiliary plant and portable test equipment.

Services	In the context of this suite of documents this is the term used for, but not limited to, the services provided within the telecommunication and computing technical specifications to encompass requirements such as those of software and communication link systems.
Environmental Conditions	IEC 50(151)-04-05 defines these as: those characteristics of the environment such as altitude, temperature, and humidity, which may affect performance. Clauses 1.3 and 3 of this document NGTS 1 should be read together with the IEC terms Normal and Special Service Conditions defined in IEC 60694 .

3 NORMAL AND SPECIAL SERVICE CONDITIONS

G 3.1 General

In addition to the following specific environmental exposure requirements those of clause 6.2, and the more detailed requirements of the relevant lower level NGTS documents are applicable to all products ie plant, equipment, apparatus and services for [use by NGC or Other Users seeking Type Registration Category G](#).

G 3.2 Normal Service Conditions

Unless otherwise specified in clause 6.2.2 the normal service conditions of BSEN 60694 which are specifically applicable to switchgear and controlgear, shall also be applicable to other substation plant, equipment and apparatus items. The following NGC selection of BSEN 60694 values has been made.

3.2.1 Indoor

- (i) Temperature class minus 5 indoor.

3.2.2 Outdoor

- (i) Temperature class minus 25 outdoor.
- (ii) Ice coating class 10 mm.

3.2.3 Normal Service Conditions for Other Users

Other Users may wish to select [other](#) values relevant to the site conditions of a specific location. Where this is done clause 1.2 is applicable.

G 3.3 Special Service Conditions

3.3.1 Pollution Level

[The](#) pollution level for [NGC](#) substation plant, equipment and apparatus [and that of Other Users seeking Type Registration Category G](#) is Level III - Heavy according to Table 1 of IEC 815 [and as required in NGTS 2.2](#). The requirement for overhead lines is detailed in the lower level NGTS 3.4 series of documents.

Where Other Users specify [different](#) special service conditions for the directly connected circuit, whether for outdoor use or for other reasons, the requirements of clause 1.2 shall be satisfied.

4 SYSTEM CONDITIONS

G 4.1 General

In addition to satisfying the ratings specified in clause 5, it is mandatory that all plant, equipment and apparatus shall be designed to operate under the following system conditions.

G 4.2 System Voltage

4.2.1 Normal System Voltages

All high voltage plant, and as appropriate other products correctly used on the NGC System, shall satisfy their specified functional and performance requirements when operating within or exposed to, the range of voltages given in Table 1.

Table 1 System Voltage

Nominal System voltage	400 kV	275 kV	132 kV	13 kV tertiary
Maximum continuous System voltage	420 kV	302.5 kV	145 kV	16.9 kV
Minimum continuous System voltage	360 kV	247.5 kV	119 kV	10.4 kV
Rated voltage of plant	420 kV	300 kV	145 kV	17.5 kV

G 4.3 System Frequency

4.3.1 Normal System Frequency

The extremities of the range of frequency conditions under which products are expected to operate satisfactorily, on a continuous basis, are defined in Table 2.

Table 2 System Frequency

Rated frequency	50 Hz
Maximum continuous frequency	50.5 Hz
Minimum continuous frequency	49.5 Hz

G 4.4 Earthing of System Neutral

Suppliers to NGC and Other Users shall be aware that the NGC System neutral earthing arrangements are, as detailed in Table 3.

Table 3 Earthing of System Neutral

Nominal Voltage kV	Max Earth Fault Factor	First-pole-to-clear Factor	Earthing Type
400, 275, and 132	1.4	1.3	Multiple direct
13 kV tertiary	Site specific	Site specific	Site specific

4.5 Fault Clearance

G

4.5.1 Fault Current Interruption Time and Fault Clearance Time Requirements

The System characteristics for fault detection and interruption are detailed in [CI 101](#) and in part repeated here [as requirements](#).

For main protection systems the target fault current interruption times of the main fault infeeding circuit-breakers from fault inception to circuit-breaker arc extinction are given below. These times are for all fault conditions on any part of the transmission system, including the direct connections of Other Users.

- (i) 80 ms for connections at 400 kV
- (ii) 100 ms for connections at 275 kV
- (iii) 120 ms for connections of 132 kV
- (iv) Max of 35 msec protection time + 40 ms (typical value of 13 kV circuit-breaker break time) for connection at 13 kV

These requirements are necessary to achieve the NGC target total fault clearance times (opening of all circuit-breakers capable of supplying fault current infeed) of:

- (i) 140 ms for connections at 400 kV
- (ii) 160 ms for connections at 275 kV

Longer operating times may be permitted at certain sites and these times will be specified in the Contract [Enquiry](#) documentation by NGC, or [as agreed](#) at the time of Supplemental Agreement for Other Users.

In the event of failures of main protections, back-up protection shall clear the faults within a target clearance time not normally exceeding 500 ms at 400 kV and 275 kV. However, 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, capable of supplying a fault infeed, within a target fault clearance time not exceeding 300 ms.

At the NGC 132 kV system interface the slowest fault clearances are via back-up protection for which the operating time shall be no longer than 1.5 s.

4.6 Multi-pole Opening/Tripping and Auto-reclosing

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4.6.1 Multi-pole Opening/Tripping for All Users

[Simultaneous](#) three-phase opening/tripping of circuit breakers is required on all circuits.

4.6.2 Auto-reclosing for NGC

Simultaneous three-phase auto-reclosing is required on all NGC overhead line feeder circuits. Further details of the auto-reclosing requirements are given in the lower level NGTS documents.

G 4.6.3 Auto-reclosing for Other Users

Details of the auto-reclose requirements for Other Users shall be agreed at the time of Supplemental Agreement.

G 4.7 Controlled Switching of Circuit-breakers

Where mechanically switched capacitor (MSC) banks or shunt reactors are specified in the Contract Enquiry Document for NGC or as agreed at the time of Supplemental Agreement for Other Users, controlled, point-on-cycle, switching schemes are specified for the associated circuit-breakers. The requirements for these are detailed in the appropriate lower level NGTS documents.

5 HIGH VOLTAGE PLANT RATINGS

G 5.1 General

The plant ratings shall be demonstrably suitable for the requirement of the NGC System at the point of connection of the NGC plant or direct connection point of Other Users.

For rationalisation purposes NGC specifies a main and special case rating for switchgear and these are detailed in Tables 4, 6 and 7. The intention is to cover the requirements of the majority of potential locations and applications on the NGC System with these values. Table 5 details NGC=s selected rating values for transformers. Other Users seeking Type Registration Category G shall use the same values. As stated in clause 2.3 only switchgear products are normally relevant to the Direct Connection of Other Users. Hence only sub-clause G5.2.1 is relevant to NGC Type Registration Category G.

Where the NGC System characteristics, or those of Other Users= direct connections, require a rating more, or substantially less, severe than the IEC values selected and detailed in Tables 4, 5, 6 and 7 they are limited in application and hence site specific. They will be specified, usually from the IEC range of values, by NGC in the Contract Enquiry Document. The requirements of clause 1.2 shall be satisfied by Other Users.

5.2 Primary Currents

G 5.2.1 Switchgear

The rated normal currents have been selected from the R10 series of IEC 59.

Note: The R10 series comprises the numbers 1.0 / 1.25 / 1.6 / 2.0 / 2.5 / 3.15 / 4.0 / 5.0 / 6.3 / 8.0 multiplied by 10^N where N = 0,1,2,3, etc.

The following ratings are specified for switchgear used on the NGC System and are the main and, where applicable, single alternative values selected for the NGC System. Other Users should consider these values and clause 5.1 when specifying the primary current ratings of switchgear at the direct connection.

Table 4 NGC Current Ratings

Nominal Voltage	Current Rating	
	<u>Main</u>	<u>Special Case</u>
<u>400 kV</u>	<u>4000 A.</u>	<u>6300 A</u>
<u>275 kV</u>	<u>2500 A.</u>	<u>3150 A</u>
<u>132 kV</u>	<u>2000 A.</u>	<u>3150 A</u>
<u>13 kV tertiary</u>	<u>4000 A.</u>	<u>No special case</u>

5.2.2 [Power](#) Transformers

Primary currents are not directly specified but can be determined from the specified MVA rating of the transformer, by assuming nominal system voltage. Standard ratings are given, with other ratings being site or application specific and specified by the Contract [Enquiry](#) documentation.

Table 5 Ratings of Transformers used by NGC

Nominal Voltage	Rating MVA
400/275 kV	1000, 750 , and 500
400/132 kV	240
275/132 kV	240, 180, and 120

5.2.3 Quadrature-boosters and Reactors

The ratings of quadrature-boosters, and series- and shunt-reactors are detailed in the lower level NGTS documents.

5.2.4 Overhead Lines

The thermal ([continuous current](#)) and mechanical ratings of equipment for use on overhead lines are defined in NGTS 2.4 and related Level 3 documents.

5.2.5 [Power](#) Cables

The electrical, thermal and mechanical ratings of equipment for use on cable circuits are defined in NGTS 2.5 and related Level 3 specifications.

[The required current \(or MVA\) rating of power cables shall be defined in the Contract Enquiry document.](#)

5.3 Plant Short-circuit Current Ratings

5.3.1 Short-circuit Current Values for NGC Use

The rated short time withstand current of appropriate plant, equipment and apparatus has been selected as required by BSEN 60694 in accordance with the R10 series of IEC Publication 59. (See also clause 5.2.1).

Table 6 details the main and [special case](#) value of three-phase and single-phase current for plant, equipment and apparatus used on the NGC System. For a limited number of locations, further enhanced, or reduced, ratings may be specified on a site specific basis.

Table 6 Three-Phase and Single-phase Short Circuit Ratings

System Voltage	Short Circuit Rating		Duration of Short Circuit
	Main	Special Case	
400 kV	63 kA	50 kA	1 Sec
275 kV	40 kA	31.5 kA	1 Sec
132 kV	31.5 kA	40 kA	3 Sec
13 kV tertiary	50 kA	None	1 Sec

5.3.2 Circuit Time Constants, and Making Peak and Peak Withstand Factors [for NGC Use](#)

Both the main and the [special case](#) short-circuit current ratings may be associated with a main and [a special case](#) time constant as detailed in Table 7.

Note: The selected time constant is of particular importance to the circuit-breaker making and breaking ratings and the switchgear peak withstand ratings. In line with international documentation in [particular the 1999 CDV revision of IEC 60056](#), the main value of time constant is selected as 45 ms and the [special case](#) value is 60 ms, based on X:R values of 14 and 18.9 respectively. As a consequence the making peak and peak withstand factors for the short-circuit current are 2.5 for the main and 2.7 for the [special case](#) values of time constant. These values of time constant are expected to be adequate for at least 90% of applications, with the main value being appropriate for at least 80%.

The purpose of the [special case](#) value is to assist rationalisation of an internationally agreed value for more severe requirements above the main value. This reduces the need for a series of separate site specific values, whilst avoiding over specification of the main value.

The [special case](#) value will not be specified where it is not required.

It is recognised internationally that values more severe than the [special case](#) value of time constant [and peak factors](#) do occur, such as at concentrations of generation and transformation. In such circumstances and following technical appraisal, [other](#) values may be specified by NGC, on a site specific basis, in the Contract [Enquiry](#) document.

G 5.3.3 Short-circuit Current and Circuit Time Constant Values Applicable to Other Users

For the directly connected plant of Other Users, the short-circuit [rating](#) fault [level](#) and time constant [values shall be agreed to be relevant for](#) the [direct connections](#) including the appropriate contribution from the NGC System at that point and within the interface [protection](#) zone. The values will be agreed at the time of Supplemental Agreement. [However, for Type Registration Category G, Other Users shall comply with values selected from Table 7.](#)

Table 7 Matrix of Main and [Special Case](#) Short-circuit Ratings for NGC Application

System Voltage kV	Plant Rated Voltage kV	Short-circuit Current					
		Main Current Value and Choice of Time Constant and (X:R)			Special cases		
		Current kA	Time Constant in ms and (X:R ratio)	Peak Factor (rationalised values)	Current kA	Time Constant ms and (X:R)	Peak Factor
400	420	63	45 (14)	2.5	50	45 (14)	2.5
			60 (18.9)	2.7		60 (18.9)	2.7
275	300	40	45 (14)	2.5	31.5	45 (14)	2.5
			60 (18.9)	2.7		60 (18.9)	2.7
132	145	31.5	45 (14)	2.5	40	45 (14)	2.5
			60 (18.9)	2.7		60 (18.9)	2.7
13	17.5	50	96 (30)	2.7	None	None	None

Note: The NGC main choice ratings are shown in **bold** in the shaded area of the table.

[G](#) 5.4 Rated Insulation Level and Protective Gap Settings

The values of rated insulation level and the protective gap settings, in Tables 8 and 9 are related to the design of the NGC system. The values chosen align with the IEC standardised values which are tabulated in BSEN 60071 and other documents. These are the values applicable on the NGC System and at the [Direct Connection](#) by Other Users.

Alternative values may be specified separately, following insulation co-ordination studies or where surge arresters are applied. The NGC surge arrester requirements are detailed in the lower level NGTS specifications. Where [insulation co-ordination studies or surge arresters are being](#) adopted by Other Users, for [the Direct Connections](#), [this](#) shall be [agreed at the time of the Supplemental Agreement and shall](#) satisfy the requirements of clause 1.2.

[However, for Category G Type Registration \(see clause 9\) the values in Tables 8 and 9 are required.](#)

5.4.1 Primary Plant Rated 420 kV and 300 kV

Table 8 Rated Insulation Levels 420 kV and 300 kV Plant

Nominal System Voltage	kV	400	275
Rated Voltage for Plant	kV	420	300
(i) Rated lightning impulse withstand voltage to earth (1.2/50 μ s wave)	kV peak	1425	1050
(ii) Rated lightning impulse withstand voltage between poles (1.2/50 μ s wave)	kV peak	1425	1050
(iii) For switching devices (including disconnectors) rated lightning impulse voltage withstand between terminals on one pole when open (impulse waveshape 1.2/50 μ s)		1425 kV impulse plus 240 kV peak power frequency voltage	1050 kV impulse plus 170 kV peak power frequency voltage
(iv) Rated switching impulse withstand voltage to earth (250/2500 μ s wave)	kV peak	1050	850
(v) Rated switching impulse withstand voltage between poles (250/2500 μ s wave)	kV peak	1575	1275
(vi) For switching devices (including disconnectors) rated switching impulse withstand voltage between terminals of one pole when open (impulse waveshape 250/2500 μ s)		900 kV Impulse plus 345 kV peak power frequency voltage	700 kV Impulse plus 245 kV peak power frequency voltage
(vii) Overhead Line Arcing Gaps (Mid-line)	<u> </u> m	<u>2.80</u>	2.13
(viii) Overhead Line Arcing Gaps (First 1.6 km from the substation)	<u> </u> m	<u>2.50</u>	1.90
(ix) Transformer and Reactor Coordinating Gaps (screened gap) (see Note 1)	<u> </u> m	1.50	1.20
(x) Cable Sealing Ends Arcing Gaps	<u> </u> m	2.54	1.90
Note 1: Existing transformers and reactors may <u>have an un-screened loop-loop gaps where the gap is</u>	<u> </u> m	1.68	1.22

5.4.2 Primary Plant Rated 145 kV and Plant Connected to 13 kV Transformer Tertiaries

Table 9 Rated Insulation Levels for 145 kV Plant and for 13 kV Tertiary Connected Plant

Nominal System Voltage	kV	132	13
Rated Voltage for Plant and Equipment	kV	145	17.5
(i) Rated lightning impulse withstand voltage to earth (1.2/50 μ s wave)	kV peak	650	95
(ii) Rates lightning impulse withstand voltage between poles (1.2/50 μ s wave)	kV peak	650	95
(iii) For switching devices other than disconnectors and switch-disconnectors rated lightning impulse withstand voltage between <u>terminals on</u> one pole <u>when open</u> (1.2/50 μ s wave)	kV peak	650	95
(iv) For disconnectors and switch-disconnectors rated lightning impulse withstand voltage between terminals <u>on</u> one pole <u>when open</u> (1.2/50 μ s wave)	kV peak	750	110
(v) Rated power frequency dry withstand voltage (1 minute)	kV	275	38
(vi) For open type equipment rated power frequency wet withstand voltage (1 minute) (<i>preferred method is BS923</i>)	kV	275	38
(vii) Across the isolating distance of disconnectors rated power frequency dry, and where applicable wet, withstand voltage (1 minute)	kV	315	45
(viii) Overhead Line Arcing Gaps (Mid-line)	<u> </u> m	1.10	N/A
(ix) Overhead Line Arcing Gaps (first 1.6 km from the substation)	<u> </u> m	1.00	N/A
(x) Transformers and Reactor Coordinating Gaps (see Note 1)	<u> </u> m	0.66 screened gap	0.10 arcing gap
(xi) Cable Sealing Ends Arcing Gap	<u> </u> m	1.00	0.10

Note 1: Existing 132 kV transformers and reactors may have un-screened loop-loop gaps where the gap is 0.66 m.

6 GENERAL REQUIREMENTS

6.1 Health and Safety

6.1.1 NGC Owned Plant, Equipment, Apparatus and Services

All products supplied to and installed on the NGC System or property, and owned and operated by or on behalf of NGC, shall meet the relevant Health and Safety requirements listed in clause 2 (REFERENCES) when erected, operated and maintained in accordance with procedures laid down by the Supplier and where appropriate agreed by NGC at the time of NGC Type Registration. The Supplier shall take due regard of the working environment and operating duty to which the plant, equipment, apparatus or service is to be exposed as stated by NGC in this document, other relevant NGTS specifications and the Contract Tender Document.

G 6.1.2 Plant, Equipment, Apparatus and Services Owned by Other Users

Notwithstanding the requirements of clause 1.2, Other Users are responsible for the Health and Safety considerations of products in their ownership, and as legally required at shared locations, the responsibility is by agreement.

6.2 Environmental Exposure Conditions of Plant, Equipment and Apparatus for NGC

6.2.1 High Voltage Switchgear and Associated Controlgear for use by NGC

The Normal and Special Service Conditions are detailed in clause 3 of this document.

In addition, associated controlgear and other equipment housed within outdoor High Voltage switchgear shall be provided with a degree of protection conforming to at least classification IP54 in BSEN 60529.

6.2.2 Equipment Other than High Voltage Switchgear and Associated Controlgear for NGC

For convenience, the locations in which equipment may be installed by NGC have been divided into six environmental classes, with an additional class for storage and transportation. The classes are shown in Table 10 and cover most applications. For ventilated equipments, the ambient temperature is defined as being the free air temperature existing at a point level with the top of the equipment.

Table 10 Temperature and Humidity Environmental Classes for NGC

Class	Siting Conditions	BSEN60654-1 Class	Ambient Temperature Range (Note (iii))	Relative Humidity Limits
1	Rooms having a closely controlled environment (Note (ii))	A1	+18 to +27°C	20 to 75%
2	Control rooms and equipment rooms not fully air conditioned	B3	+5 to +40°C	5 to 95% (Note (iv))
3	Plant areas, <u>rooms</u> and block houses away from high temperature plant and subject to greater extremes than Group 2	N/A	-10 to +55°C	5 to 95% (Note (iv))
4	Outdoors	C2	-25 to +55°C	10 to 100%
5	Adjacent to high temperature plant	N/A	-10 to +85°C	10 to 100%
6	Normal transit and storage conditions (Note (i))	N/A	-25 to +70°C	20 to 95%

Notes to Table 10:

- (i) Refer to BSEN 60068-2.
- (ii) Where equipment is required to continue functioning despite failure of air conditioning plant, the environment which would result from these conditions shall be ascertained and the class relevant to that environment specified instead. Fans and air conditioning plant may still, of course, be used to prolong the life of the equipment.
- (iii) Due regard shall be taken of the increase in the above temperature maximum when the equipment is mounted in enclosures, eg cubicles, boxes, etc without adequate ventilation.
- (iv) Some equipments (eg Protection) are only tested to withstand a Relative Humidity of 93%.

6.2.3 Other Plant and Apparatus for NGC Use

The requirements for other plant and apparatus shall be as defined in clause 3 or the appropriate lower level NGTS documents.

6.3 Environmental Impact

6.3.1 In line with international and national concerns and proper commercial considerations NGC aims to minimise the environmental impact of the products used on its transmission system.

To this end Suppliers to NGC shall declare, at the time of Type Registration, the materials considered environmentally hazardous and the safe means of handling and disposal of them as required by the CDM Regulations

6.4 Auxiliary Supplies for Use in NGC Substations and Required for the Interfacing Equipment of Other Users

G 6.4.1 Auxiliary Supplies: General

The values specified below are selected from the IEC standardised values for use in NGC substations, control rooms, relay rooms etc and unless otherwise directed at the time of NGC purchase, the Supplier shall state which of these selected values is applicable to the plant and equipment being supplied.

G 6.4.2 NGC - Other User(s) Auxiliary Supplies Used at the Interface

Where interface arrangements between NGC and Other User(s) require it, the Supplier shall confirm compatibility with the range of selected values, detailed in clauses 6.4.3 to 6.4.7, at the time of Type Registration, as detailed in clause 9. The auxiliary supply voltages at the NGC - Other User(s) interface shall be agreed at the time of Supplemental Agreement. Where such interface compatibility is not required, the Other User(s) need only satisfy the requirements of clause 1.2.

G 6.4.3 Auxiliary Supply Voltages

- (i) 48 V d.c. nominal, operating at 54 V
- (ii) 110 V d.c. nominal, operating at 125 V
- (iii) 400 V three phase, and 230 V single phase a.c. nominal at 50 Hz

All d.c. fed equipment, except solenoid closing equipment, shall be designed to work at the operating values in (i) and (ii) and over the appropriate range as detailed in lower level NGTS documents.

The normal arrangement for earthing of the d.c. supply is by centre point earthing.

G 6.4.4 Rated Supply Voltage for Auxiliary Motor Drives

The rated voltages selected for auxiliary motor drives for switchgear equipment (eg oil pumps, unit compressors and disconnecter drive motors) are 400 V a.c. and 110 V d.c. nominal. The Supplier shall state the current consumption of the circuit.

G 6.4.5 Rated Supply Voltage for Telecommunication and Control Equipment

The rated voltage selected for Telecommunications equipment is 48 V d.c. nominal. Control equipment standard voltages are 48 V d.c., 110 V d.c. and 230 V a.c. nominal. The Supplier shall state the current consumption of the circuit for each voltage.

G 6.4.6 Rated Supply Voltages for Protection Equipment

The rated voltage selected for the auxiliary energising supply for major electronic protection relays is either 110 V d.c. or 48 V d.c. nominal. The rated voltage for protection tripping systems and for tripping and closing circuits of circuit-breakers is 110 V d.c. nominal. The Supplier shall state the current consumption of the circuit for each voltage.

G 6.4.7 Rated Supply Voltage for Other Ancillary Electrical Equipment

The rated supply voltage selected for other ancillary electrical equipment shall be in accordance with the appropriate NGTS Level 2 or 3 document.

6.4.8 Rated Supply Voltage of Closing and Opening Devices

The rated voltage selected for closing and opening devices is 110 V d.c. The range for this operating voltage is given in NGTS 2.2: Switchgear.

G 6.5 Date Proofing of Systems Used in Plant, Equipment, Apparatus and Services

The Supplier of products ie plant, equipment, apparatus and services, for use by NGC and by Other Users at the Direct Connection, shall demonstrate that, where the products incorporate systems with date sensitive elements, these are designed to ensure that any date (historic, present or future) does not prevent that product from performing correctly during its life.

7 QUALITY ASSURANCE ARRANGEMENTS APPLICABLE TO PLANT, EQUIPMENT, APPARATUS AND SERVICES

7.1 General

7.1.1 The NGC requirements are detailed in clauses 7.2 and 7.3.

G 7.1.2 Other User(s) shall ensure that appropriate, demonstrably compatible, quality assurance arrangements exist within their Suppliers= organisations to satisfy the requirements of clause 1.2 of this document and the Grid Code.

7.2 General Quality Assurance Arrangements for NGC Suppliers

7.2.1 The Supplier to NGC shall advise NGC of the arrangements for assurance of quality that have been made by the supplier of that product. These arrangements shall include as a minimum, details of the procedures for controlling the specification/development, design, manufacture, test, installation and commissioning of that product.

7.2.2 The minimum Standard for quality assurance arrangements shall be BS EN 9001.

7.3 Quality Assurance Arrangements for NGC Type Registration of Plant, Equipment, Apparatus and Services

7.3.1 Unless otherwise specified in the relevant Level 2 or Level 3 NGTS specifications, it shall be a requirement for Type Registration Categories P, C, B, or A (as defined in clause 9), that the manufacturer shall demonstrate current third party quality assurance certification to BS EN 9001 (or an equivalent alternative agreed with NGC) with a relevant scope of supply.

7.3.2 Where the satisfactory operation of equipment is critically dependent on software, the manufacturer shall demonstrate current third party quality assurance certification to BS ISO 9000-2 as part of the Type Registration process.

G 7.3.3 For Type Registration Category G_s the requirements of clause 7.1.2 apply.

8 TESTING REQUIREMENTS

8.1 General Test Requirements for Suppliers to NGC

8.1.1 As required by the Type Registration arrangements of clause 9, the Supplier shall be able to demonstrate compliance with all of the requirements in the appropriate NGTS documents through appropriate test evidence which shall be available to NGC for inspection on request. The evidence shall be written in English, unless otherwise agreed with NGC.

8.1.2 Where tests are to be performed, then the Supplier shall submit a detailed programme of testing, with at least 10 working days notice. NGC will specify which tests will be witnessed by NGC or its representative.

- 8.1.3 The Supplier shall be responsible for the provision of, suitable, test equipment which has been calibrated to a traceable source. The Supplier shall employ experienced test personnel and be responsible for the clear identification of the test object, and the preparation of a test report. The report(s) shall demonstrate that the plant, equipment, apparatus or service meet the compliance levels for the relevant clause(s) of the appropriate NGTS document(s) and can be traced to production units.
- 8.1.4 Where NGC witness tests, the results shall be made available at the time of test wherever possible and the reports shall be received by NGC within 8 weeks of test completion.
- 8.1.5 In the case of all tests including mechanical withstand tests, the required measurements, such as voltage, current, strain and pressure together with any appropriate transients, shall be recorded in a permanent form suitable for inclusion in test reports.

G 8.2 General Test Requirements for Other Users

- 8.2.1 Where the requirements of clause 8.1 are not applied by the Supplier of products to Other Users, it is incumbent upon the Suppliers, or Other User, to demonstrate to NGC that the test arrangements adopted are compatible with the requirements of clause 8 as a whole and satisfy the requirements of clause 1.2.

G 8.3 Type Tests for Plant, Equipment, Apparatus and Services for NGC and Other Users

All plant, equipment, apparatus and services for use on, or directly connected to, the NGC System shall be fully Type Tested.

The Type Tests specified in the NGTS Level 2 and Level 3 documents are, where applicable, in accordance with the appropriate European, IEC or British Standards and Specifications. In some cases, enhanced test requirements are specified to match specific NGC System needs.

The Supplier is responsible for organising and performing Type Tests. These tests shall demonstrate that the design characteristics of the product under test are compliant with the functional and performance requirements of the appropriate NGTS specifications or relevant specified standard. Type Tests are normally made once only and repeated only when the design, materials, method or place of manufacture of the product is changed. The Supplier is responsible for notifying NGC of such changes.

NGC reserves the right to witness Type Tests on all products to be used by NGC, or to be supplied with suitably authenticated documentation to confirm that Type Testing has been performed, in accordance with the NGTS specifications applicable to the product.

The nature, extent and test conditions of the Type Tests to be performed, together with the required documentation, will be specified in the appropriate Level 2 or Level 3 NGTS documents. The tests specified in NGTS documents do not, in any way, absolve the Supplier of the responsibility to meet the functional and performance requirements defined within these specifications.

G 8.4 Routine Tests

Where routine tests and inspections are performed by the Supplier at the completion of manufacture of the product, then the requirements of these tests may where appropriate be specified in the relevant NGTS document; in which case the programme of tests shall be agreed at the time of NGC Type Registration.

Any variation to this programme shall be agreed at the time of either, purchase, in the case of Suppliers to NGC, or Supplemental Agreement in the case of Other Users.

Where separately specified as a requirement for NGC products, NGC reserves the right to witness routine tests, or be supplied with suitably authenticated documentation to confirm that routine testing has been performed satisfactorily.

8.5 Sample Tests

Sample tests are intended to verify that the design characteristics of the Type Registered products are achieved in the production batch. This is normally made by repeating an agreed selection of some Type Tests on a representative production sample.

Where separately specified as a requirement for NGC products, NGC reserves the right to witness sample tests, or be supplied with suitably authenticated documentation to confirm that [sample testing](#) has been performed satisfactorily.

The nature, extent and test conditions of the sample tests to be performed, together with the required documentation, will be specified by the Supplier and submitted to NGC for consideration. Where required, the specific details of tests and overall testing programmes are described in the appropriate Level 2 or Level 3 NGTS documents.

8.6 Commissioning Tests (performed prior to first energisation or use on the NGC System)

8.6.1 Commissioning Tests for all Plant, Equipment, Apparatus and Services for NGC Use

The Supplier shall demonstrate, by performing Commissioning Tests, that the product meets the functional and performance requirements of the NGTS documents, when installed to the Supplier's specifications and as agreed by NGC. The Supplier shall provide the appropriate Testing Equipment to demonstrate this. The nature, extent and test conditions of the commissioning tests to be performed at site are specified in the appropriate Level 2 or Level 3 NGTS documents, the agreed NGC Site Commissioning Test Sheets, or the contract specification.

The Supplier of the product shall provide details of his recommended commissioning tests as part of the documentation required for NGC Type Registration of that product (see clause 9).

Note: These tests are referred to as off-load commissioning tests in NGC internal procedures.

G 8.6.2 Commissioning Tests for Other Users

The commissioning tests shall be consistent with the need for the Other User(s) to satisfy the Grid Code and clause 1.2.

G 8.7 Energisation and On-load Commissioning Tests

The requirements and responsibilities for these tests, where the [NGC product or that at the connection point](#) is first energised (used) on the NGC System, are specified in the Contract Tender Document or Supplemental Agreement, as appropriate.

Note: These are referred to as commissioning tests in NGC internal procedures.

8.8 Maintenance Testing

8.8.1 Maintenance Testing for all Plant, Equipment, Apparatus and Services for NGC Use

Maintenance Tests are those performed during the life of the product. The Supplier shall specify the nature, and frequency, of any maintenance testing required in order to ensure that the security of service and performance of the product meet the requirements of the relevant NGTS Level 2 and Level 3 specification, together with the Supplier's claims, throughout the life of the product.

This pattern of maintenance testing may where appropriate be agreed with NGC at the time of Type Registration and may be amended, by agreement with NGC, at the time of purchase.

The Supplier of the product shall provide details of his recommended maintenance tests as part of the documentation required for NGC Type Registration of that product (see clause 9).

G 8.8.2 Maintenance Testing for Other Users

The maintenance test regime of Other Users shall be consistent with the requirements of the Grid Code and clause 1.2.

9 TYPE REGISTRATION ARRANGEMENTS FOR PLANT, EQUIPMENT, APPARATUS AND SERVICES FOR USE ON AND DIRECTLY CONNECTED TO THE NGC SYSTEM

9.1 General

G 9.1.1 Type Registration

It is the Policy of NGC, following evidence of satisfactory completion of Type Tests and/or where appropriate field experience, to Type Register all plant, equipment, apparatus and services to National Grid Technical Specifications (NGTS) for use on, or direct connection to, the NGC System. Hence, NGC will only purchase, or allow connection of, such Type Registered items. The granting of Type Registration for such products requires the Supplier, or Other User(s), to produce a Self Certification Statement which confirms compliance with each clause of the NGTS specification appropriate to the product. Type Registration does not absolve the Supplier or Other Users, from the responsibility of ensuring that the product meets the functional and performance requirements specified in the appropriate NGTS document or that the requirements of clause 1.2 are satisfied. Type Registrations will be periodically reviewed by NGC in conjunction with the Supplier.

9.2 Self Certification Statement

9.2.1 Self Certification Statement of Supplier to NGC

The Supplier shall state that the plant, equipment, apparatus and services, proposed for use on the NGC System, satisfies the requirements of the relevant NGTS documents, including Type Testing, and is fit for the applications for which it is to be supplied. The Statement shall also recognise the Supplier's obligations, and confirm compliance with the relevant UK Statutes and Regulatory documents applicable to the product supplied.

G 9.2.2 Self Certification Statement of Suppliers to Other User(s) or of Other Users

The Suppliers to Other Users or Other Users themselves as appropriate, shall provide a statement that the plant, equipment, apparatus or service, proposed for direct connection to the NGC System, satisfies the requirements of the relevant NGTS documents, including Type Testing, and is fit for the applications for which it is to be supplied. The statement shall also recognise the obligations of the Supplier, or the Other User as appropriate and confirm compliance with the relevant Legislation applicable to the product supplied.
Alternatively, the requirements of clause 1.2 shall be satisfied.

9.3 Evaluation

G 9.3.1 Review of the Self Certification Statement

NGC will review the Self Certification Statement, to accept or otherwise the declarations of compliance made, against the requirements of NGTS documents.

G 9.3.2 Audit of the Self Certification Statement

NGC will audit the Self Certification Statement and accompanying evidence to identify non-conformances. The depth of this audit process will vary depending on the product or service, the Supplier or Other User, and the needs of NGC. Non-conformances may result from, for example:

- (i) Failure of the supporting documentation to align with the Self Certification Statement.
- (ii) Type Test procedures being inadequate.
- (iii) Type Test certificates and/or reports being inadequate.

All non-conformances will need to be resolved with the Supplier or Other User before Type Registration can be conferred.

G 9.3.3 Additional Evaluation Criteria

Evaluation for Type Registration will take into account NGC=s and those of Other Users as stated in clause 1, duties and obligations for safety and security of the NGC System.

As an adjunct to the Type Registration process, NGC reserve the right to evaluate the following:

- (i) Adequacy of the implementation of the manufacturer=s Quality Management System. (See also clause 7)
- (ii) All samples submitted for Type Test are representative of the production items.
- (iii) Consistency of production following Type Test.

9.4 Documentation for Type Registration

G 9.4.1 The nature and extent of the documentation required for NGC Type Registration is indicated in clause 8 for test evidence and test requirements, and specified for other types of documentation in clause 10, and also in the appropriate NGTS Level 2 and Level 3 documents. The requirements usually align with the appropriate IEC documentation.

9.5 NGC Type Registration Categories

NGC has five categories of Type Registration which form a hierarchical structure from the lowest level P, C (G if appropriate) B and then A as full Type Registration, the five categories are:-

- 9.5.1 Category P (Provisional) - An item of plant, equipment, apparatus or a service which has been granted Category P Type Registration has been assessed for compliance with relevant NGTS or other Specifications and, while it appears capable of achieving compliance, deficiencies in testing and/or evidence have been identified, and actions required to achieve compliance agreed with the Supplier. Products in this category can be offered against Contracts and may be ordered by NGC, subject to contractual agreement with the Supplier that prior to commissioning the agreed outstanding testing will be completed and test reports and other evidence of performance, sufficient to grant Category B Type Registration, produced as part of Self Certification.
- 9.5.2 Category C (Contract) - A product for which NGC Type Registration has been granted only for use for a specific contract, location, or circuit.
- 9.5.3 Category B (Qualified) - A product for which the NGC Type Registration assessment is complete but the product may have restricted application on the NGC System due to limited service experience or specific performance limitations.
- 9.5.4 Category A (Full) - A product which is fully compliant and has sufficient service experience to allow its unrestricted use on the NGC System within its Type Registered scope. In the case of a new product it is likely that an initial Category B Type Registration will be upgraded to Category A Type Registration subject to suitable service experience.

G 9.5.5 Category G (Grid direct connection) - A product for which sufficient Type Test evidence and demonstrable compatibility exists to enable Other Users to use it for direct connection to the NGC System. NGC Type Registration to this category is strictly limited to such direct connections and does not apply to use by NGC for its own purposes where category P, C, B, or A are applicable. Many products will be granted both category G and category P, C, B or A. Products granted category B may and A will automatically be granted category G.

When the Other User is responsible for and maintains the Self Certification Statement, they shall demonstrate, by means of the Self Certification Statement, that the requirements of clause 1.2 are not compromised by lack of knowledge, or access to knowledge, about the plant, equipment, apparatus or service. This shall be done at the time of NGC Type Registration to Category G

Note: Where Other User(s) seek NGC Type Registration to Category G for previously un-registered items, they must be aware that NGC Type Registration is not automatic and the duration of the process may impose a time constraint on any linked contract. This is especially likely where the Other User has not ensured compliance prior to seeking NGC Type Registration. However, NGC will consider all applications promptly and without unreasonable delay.

9.6 Review of Type Registered Status to Retain Continued Type Registration of a Product

G 9.6.1 Where the design of a product has been Type Registered by NGC it is the responsibility of the Supplier (or Other User) to notify NGC of any design changes, method or place of manufacture. NGC will assess the need for re-registration of the product. Where a product fails in service due to a design inadequacy or generic manufacturing defect, NGC may withdraw Type Registration and will not procure the product until Type Registration is re-instated.

G 9.6.2 Design changes include, but are not limited to, changes in dimensions, tolerances, material of manufacture, heat treatment processes, fabrication method, software, circuit boards and location of manufacture. Any other design aspect which could affect the functional performance of the product shall be notified to NGC.

10 STANDARDS OF MANUALS, SUPPORT DOCUMENTATION AND DRAWINGS

10.1 General

G 10.1.1 At the time of Type Registration for the product, offered for use by NGC, the Supplier shall provide adequate documentation for Type Registration including Type Test Certificates or Reports of Performance, clearly identifying the test object, manuals, and other supporting documentation and drawings.

This documentation will be stamped NGC Type Registered and shall be used for subsequent sample tests and product validation as necessary.

Other User(s) when seeking Type Registration Category G shall satisfy these requirements otherwise they shall demonstrate to NGC that such documentation adequately exists for plant and equipment to be directly connected to the NGC system without reducing the level of security of the system, as required by clause 1.2.

10.1.2 Where applicable the information shall be in the form of clearly labelled bound manuals or be on CD ROM, or clean, clear, reproducible drawings, using internationally recognised symbols to IEC standards.

10.1.3 All manuals and drawings shall clearly indicate the product manufacturer, type and model that they refer to, and also indicate the issue date of the document/drawing.

10.1.4 The Supplier shall provide adequate site documentation for commissioning and lifetime management including manuals, test recommendations, drawings and other supporting documentation.

10.2 Technical Descriptions

- 10.2.1 At the time of Type Registration for NGC use, the Supplier shall provide a manual(s) which provide(s) a technical description and specification of the product together with details of its transportation, storage, installation, operation, commissioning, maintenance, de-commissioning and disposal, and spares requirements to achieve the agreed service life detailed in the lower level NGTS documents. It shall also include a full description of any software which is needed. The contents shall be agreed to NGC's satisfaction during the Type Registration assessment.

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