

## **The Grid Code OC7.5**

### **Integral Equipment Tests Guidance Notes**

**Prepared by National Grid (Plc)**

## NOTES

These notes of guidance have been prepared by National Grid with the aim of assisting Users in completing the relevant Schedules of the Grid Code (GC). The guidance notes do not form part of the GC, and if there is any conflict between the Guidance Notes and the GC, or any other agreement, then that agreement shall take precedence.

## DOCUMENT CHANGE CONTROL DETAILS

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## **1 INTRODUCTION**

These Guidance Notes are those referenced in the Grid Code OC7.5.3. This document has been updated to reflect the extended role of National Grid Electricity Transmission (NGET) as National Electricity Transmission System Operator (NETSO).

The guidance notes support and supplement, but do not replace, the requirements of the Grid Code to ensure that information relating to an Integral Equipment Test (IET) is communicated between Users and NGET and enable NGET and Users to adequately consider the effects of testing.

## **1.1 Objective**

The objective of these Guidance Notes is to provide Users with details of suggested procedures, information flows and responsibilities to enable the Grid Code provisions to be met. By this, the successful management and implementation of tests such as an IET can take place with a minimum effect on other systems.

## **1.2 What Is an IET?**

Any test on equipment, associated with Plant and/or Apparatus which takes place when the Plant or Apparatus forms part of a synchronised system and which may cause an Operational Effect.

The Operational Effects, which can occur during testing, are primarily MW and/or MVAR changes caused by the tests themselves. In addition, testing can introduce an increased risk of Plant trip and a corresponding loss of MW and MVAR support to the system. Any MW and/or MVAR changes can affect system frequency and/or system voltage and can therefore have a consequential effect on other Users.

Examples of the type of equipment testing to which these Guidance Notes may apply are given in Appendix A.

It is the responsibility of the User wishing to perform a test to consider whether a particular test should be notified as an IET or not. Where there is any doubt, the User in the first instance should discuss any proposed testing via the communication and liaison routes described in section 2. NGET would generally consider an IET where active power and/or reactive is/are expected to change during the test.

An IET will normally be notified as part of the Operational Planning process and may at times form part of a formal commissioning or re-commissioning programme.

## **1.3 The Need to Notify**

An IET should not have an adverse effect on the National Electricity Transmission System or User Systems connected to it provided that they are correctly coordinated between all interested parties, are correctly managed and that no unforeseen incidents occur during implementation. In order for this to happen, it is necessary for Users, NGET and Transmission Owners to be able to assess the effects of tests on otherwise normal operation.

Without the proper management and control of these tests there is the possibility that other Users of the National Electricity Transmission System will be affected by them. In some cases this could give rise to frequency control problems, voltage control and stability problems, generator instability or even system instability.

Typical examples of where inadequate co-ordination and control may cause problems and affect others are given in Appendix B.

## **1.4 Notice**

To allow adequate consideration to be given to the impact of testing, it is advisable to provide as much advance notice of tests as possible. Initial notification period of a minimum of 4 weeks prior to the test date should normally allow for reasonable interchange of information regarding the content and impact of the proposed tests. Unless otherwise agreed, details of the tests should be provided in writing/email to relevant affected parties and the response also made in writing/email. NGET will acknowledge receipt of the IET request within two weeks of initial IET request. If the test is agreed NGET, will create a TOGA booking for the test and advise the requestor two weeks ahead of the test. Any further correspondence regarding the agreed IET should quote the relevant TOGA number for ease of reference. During the week of the test to 1 day ahead, NGET and the IET requestor should confirm that the planned test is progressing at the agreed time of the day. Also see Appendix C.

At times, following plant failure, it may be necessary to undertake a test at short notice to enable a prompt return to service. The communication process and information exchange outlined in the Grid Code must still be followed to minimise the risk of events that could materially affect the system or its Users. .

The need for urgent testing as above may result in a proposal for testing being notified outside normal working hours. In these circumstances it may be necessary to communicate directly with control or operating staff e.g the NGET Control Room.

Whatever the urgency, notifications, programmes and changes should be communicated in sufficient time for the recipient to assess the implications. There may, otherwise, be a risk that a recipient may be unable to agree to the IET programme.

Appendix C gives suggested timescales, which should be followed where possible.

Appendix D gives the suggested information content of an IET notification.

## **1.5 Risks**

Proposers of an IET will need to ensure that they have considered the risks associated with testing and the impact on their equipment and systems.

Recipients will, before agreeing to an IET, need to consider the risks imposed on their own equipment and systems.

All reasonable measures to reduce risks should be taken by the proposer and the recipient.

Where a specific test within an IET programme does impose a definable and significant risk, the operational parameters that pertain to such a condition will be defined within the IET programme and all parties will be fully informed by the IET proposer prior to embarking on this particular part of the test.

## **2 GENERAL COMMUNICATION**

An IET may be carried out by a Generator, Network Operator (NO), Non-Embedded Customer (NEC), Transmission Owner (TO) or NGET and, dependent on the initiator and type of test, the necessary communications may differ. Appendix E indicates the requirements for liaison for the notification and implementation of tests by the above.

### **2.1 Generator Initiated Tests (Appendix E, Table 1)**

Power Stations comprising of Generating Units can be connected directly to the National Electricity Transmission System or be embedded in users systems. Power Stations are also further categorized into Large, Medium and Small Power Stations depending on their Registered Capacity. This potentially leads to three categories of generation, each of which may require different information flows during an IET.

For Transmission connected Generating Units and Embedded Large Power Stations it is the responsibility of the Generator to liaise with NGET and where appropriate the relevant Network Operator. NGET will consult with other NOs, TOs or NECs it reasonably believes may be affected by the proposed IET.

The Network Operator will liaise with NGET where it is aware of Embedded Medium or Small Power Stations intending to perform tests which in the reasonable judgement of the Network Operator may cause an Operational Effect.

### **2.2 Network Operator Initiated Tests (Appendix E, Table 2)**

Network Operator initiated tests may affect Transmission connected Generating Units or Embedded Power Stations, the National Electricity Transmission System and/or other Users equipment. Whenever there is doubt concerning the full effects of the tests, it would be prudent to consult with NGET. NGET will consult with the parties connected to the National Electricity Transmission System whom it believes may be affected, and Generators in respect of the effect on Embedded Large Power Stations. Liaison with other parties connected to the Network Operator network that could be affected is not part of these Guidance Notes but a matter for the appropriate Network Operator.

### **2.3 NGET or Transmission Owner Initiated Tests (Appendix E, Table 3)**

NGET or Transmission Owner initiated tests may affect Transmission connected Generating Units or Embedded Power Stations, Network Operators, or Non Embedded Customers. NGET will be responsible for liaison with those Users it judges may be affected as a result of a NGET or Transmission Owner initiated IET.

### **2.4 Tests Initiated by Non Embedded Customers (Appendix E, Table 4)**

These tests may primarily affect the National Electricity Transmission System but may also affect Transmission connected or Embedded Generating Units, and Network Operators.

### **2.5 Contacts**

The NGET contacts for the planning and implementation of IETs are shown in Appendix C. The separate contact details provided for an IET proposal for Scotland and for England & Wales reflect only NGET

internal company structure arrangements. In case of new generators, NGET's Network Operations will have a designated scheme representative who acts as an additional contact for the commissioning process. The process of IET progression is the same for Scotland and England & Wales.

Generators and Network Operators should inform NGET and other Network Operators or Generators where appropriate of their contact points for notification.

A test co-ordinator, appointed by the company initiating the test, will normally be responsible for the organisation and co-ordination of the test. Communication during the test will be between the respective operations staff.

### 3 PROCEDURES

#### 3.1 The Notification of An IET

OC7.5.5 defines the basic requirements for the notification of an IET. In Appendix D of these Guidance Notes there is a summary of the information which could be expected from a User proposing an IET.

An IET may be notified:

- a) As part of a programme for Plant and Apparatus commissioning or re-commissioning.
- b) In the case of routine or repeated tests, using standard formats as agreed from time to time between NGET and Users e.g. DAR, AVR tests.

IET notifications should where possible be in writing/email.

Appendix F shows a flow diagram for the general process of notification and liaison.

#### 3.2 Response to Notification of an IET

An IET proposal should normally be accepted when the impact on the system is minimal, not time dependent, or when times specified are precise and unlikely to be varied.

An IET proposal may be accepted conditionally subject to minor modifications such as date or time. It may be that a condition may be placed on the proposer that certain tests may only be carried out at particular times, or that, for example, plant test conditions are achieved at a slow and predetermined rate with an analysis of system effects made during this process.

If an IET is not agreed, NGET should normally be able to suggest amendments which would make the IET acceptable. For example it may be that the tests as proposed would result in unacceptable system conditions, but that modifications in terms of times, parameters or test order may make the tests acceptable.

Where the IET proposal is acceptable and a programme is agreed the IET must then be carried out in accordance with the agreed programme.

#### 3.3 Changes to Test Programme

Once agreed a test programme may only be changed in the following cases:

- a) For minor changes such as exact test sequence which can be agreed upon without the need for further test assessment
- b) When the agreed IET operating envelope is likely to be exceeded, a revised IET operating envelope should be identified and agreed with NGET. Depending on the exact circumstances and type of test, adequate time should be allowed for the affected party to assess the impact



upon their, or Users system before agreement to revised testing may be possible. Testing may need to be suspended prior to agreement.

- c) When an identifiable risk area is reached during a test programme, for example a dynamic test of the generator under-excitation limit, the test engineer or Control Engineer should inform the recipient of the IET.

### **3.4 Carrying Out the IET**

Final confirmation from the User that the IET is still planned to happen will normally be given a day before the planned test date. This provides the opportunity to discuss the final details of the IET, including limitations and descriptions of operation of Plant and Apparatus.

However, the IET should not commence before normal operational liaison has taken place, and final agreement reached between the appropriate control room staff that will be in receipt of the final agreed test programme.

Prior to reaching identifiable risk areas of the test, operating staff should inform the recipient of the IET.

### **3.5 IET Forming Part of an Agreed Commissioning Programme**

An IET may form part of an overall testing or commissioning programme where so agreed between NGET and the User. The User should submit a Gantt chart through Network Operations' scheme representative to help identify the test sequence and break points. The submitted Gantt chart should be revised if the commissioning programme changes appreciably.

In circumstances where a commissioning programme runs over several weeks or months, or where there are delays to that programme, it is particularly important that the liaison process recurs prior to the eventual implementation of an IET.

### **3.6 Complex/Long IET**

In case of a long or complex IET, uniquely identified break points should be introduced to allow tests to be discontinued and resume later on the same day or a different day altogether. Each section within the IET should be uniquely identifiable to enable ease of test continuation e.g IET No. XXXX: Test 1.

## **4 APPENDICES**

The following Appendices provide a ready reference to the following:

Appendix A	Examples of IETs
Appendix B	Examples of Problems Arising from Inadequate Test Management and Co-ordination
Appendix C	Timescales and NG Contacts for IETs
Appendix D	IET Notification – Information format
Appendix E	Communication and Liaison
Appendix F	Flow chart for IET Notification and Liaison

## APPENDIX A

### Examples of IETs

1. Voltage Control System Tests for wind-farms and Automatic Voltage Regulator (AVR) commissioning / testing
2. Power System Stabiliser (PSS) commissioning / testing
3. Under Excitation Limiter (UEL) commissioning / testing
4. Over Excitation Limiter (OEL) commissioning / testing
5. Governor/ Frequency and Load Control systems commissioning / testing
6. Transformer Tap Changer commissioning / testing
7. Overhead Line Delayed Auto-Reclose (DAR) commissioning / testing

### Other Tests notified using IET Procedures

8. Unit / Module Load Rejection
9. Reactive Capability Tests
10. Generator Risk Of Trip Due to Commissioning/Testing

### The tests listed above are the types of test which require notification as IETs.

In general, Users intending to perform a test associated with Plant and/or Apparatus forming part of a synchronised system need to consider whether a particular test should be notified as an IET.

## **APPENDIX B**

### **Examples of Problems Arising from Inadequate Test Management and Co-ordination**

#### **VAr Limiter tests on Generating Units**

Particular problems can occur with dynamic testing of excitation limiters with the generator operating with low excitation voltage. If correctly coordinated and carried out, the Generating Unit stability and local voltage control can be properly assessed against system conditions to determine an allowable test operating envelope. If not adequately coordinated, at best severe voltage changes may occur, and at worst Generating Unit instability could lead to a system wide disturbance.

#### **DAR testing by a Network Operator**

Generation embedded within a Network Operators system may be affected by high numbers of reclosing operations which can take place during this type of testing. If correctly carried out these can be minimised and system conditions co-ordinated so that local Generating Unit operating conditions are at their most favourable. If incorrectly co-ordinated, local Generating Units may experience mechanical shock and possible actual Generating Unit damage may result.

#### **Tap changer testing by NGET or Transmission Owner**

Problems may occur if excessive voltage variation takes place on the low voltage side of the transformer. If correctly carried out, these can be minimised by choosing appropriate demand and low-voltage network configurations. If incorrectly co-ordinated extreme voltage variations could occur leading to excessive tap changer operations at other voltage levels.

#### **Part or Full Load Rejection Tests**

Generator part load or full load rejection tests can result in a significant loss of MW almost instantaneously to the NETSO. This loss, depending on the size, may have a significant impact on frequency control. For this reason all tests of this nature will require a more thorough coordination between operational staff prior to these tests being undertaken. Before these tests are conducted the User must call National Grids operational staff to check that the prevailing system conditions allow the User to carry out the test.

## APPENDIX C

### Timescales and NG Contacts for IETS

Timescales	Actions	NG Contacts
4 weeks to several days ahead	This period is used to assess the implications of a test, organise resource for possible attendance, notify other Users if appropriate, and agree/disagree to the test in principle. During this period NGET will acknowledge receipt of the IET request and advise the requestor the TOGA number and contact person for the agreed IET. NGET may request for further clarification or a change of test date/time.	<u>IET in England &amp; Wales</u> Delivery team (Head – Tim Lovell) National Grid Control Center Wokingham Tel: 0118 936 3471 Fax: 0118 936 3266 e-mail: TRANREQ@NATIONALGRID.COM
Day ahead normal office days and working hours	This should be used to confirm the planned test is progressing at a certain time of day, and at a specific operating point. NGET will confirm the planned test quoting the TOGA number for the test.	<u>IET in Scotland</u> Delivery team (Head – Tim Lovell) National Grid Control Center Wokingham Tel: 0118 936 3471 Fax: 0118 936 3266 e-mail : TRSCOTLAND@NATIONALGRID.COM
Day ahead - out of normal working hours		National Grid Control Room  IET in England & Wales Transmission Security Engineer (South)
On the day	In operational timescales, successful test management is reliant on discussion between NG and other Users' control staff, working with prior knowledge of an agreed test programme / routine / procedure.	Tel: 0844 892 0365 Transmission Security Engineer -(North) Tel: 0844 892 0366 IET in Scotland

<p>Out of normal working hours</p>	<p>Urgent IETs necessary to enable return to service of plant.</p>	<p>Transmission Security Engineer Scotland (South)            Tel: 0844 892 0373            Transmission Security Engineer Scotland (North)            Tel: 0844 892 0374</p>
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## APPENDIX D

### **IET Notification:** Sample of Information Requirement from **User**

- 1 Type of Test / Description / Reason for Test / Witnessed or non-Witnessed
- 2 Plant / Circuit on which test will be carried out.
- 3 Date
- 4 Version No. of IET Notification (if applicable)
- 5 Start Time / Finish Time
- 6 Name of Test Co-ordinator and contact details
- 7 Programme of Testing and Individual Tests
  - Power Change or Range - MW and MVA<sub>r</sub> (Normally at the LV terminals)/duration
  - Type of Load Change - Step or Ramp/ load curve
- 8 Risk of Trip
- 9 Comments - including commentary on testing programme and / or other relevant information.

Note: NGET and Users may agree standard formats for the above.

## APPENDIX E

### Communication and Liaison

#### 1. Generator Initiated Tests

Type of Generator Connection	Responsibility for Liaison with NG	Responsibility for Liaison with Host NO	Responsibility for Liaison with other NOs, TOs or NECs	Test Sanction
Transmission connected Generating Unit	Generator	N/A	NGET	NGET
Embedded Large Power Station	Generator	Generator	NGET	
Embedded Medium Power Station or Embedded Small Power Station	Excluded from the scope of OC7 if the Network Operator (NO) is aware of testing taking place the NO should liaise with NGET if it is judged that there may be an Operational Effect on the National Electricity Transmission System			

## 2. Network Operator Initiated Tests

Affected Party	Responsibility for Liaison	Test Sanction
NGET	Host Network Operator	NGET
Embedded Medium Power Station and Embedded Small Power Station		
Transmission connected Generating Unit Embedded Large Power Station Non-Embedded Customer Transmission Owner Other Network Operator	NGET	



### 3. NGET / Transmission Owner Initiated Tests

Affected Party	Responsibility for Liaison	Test Sanction
Transmission connected Generating Unit Embedded Large Power Station Non-Embedded Customer	NGET	NGET
Network Operator		
Embedded Medium Power Station or Embedded Small Power Station	Network Operator	

#### 4. Non-Embedded Customer Initiated Tests

Affected Party	Responsibility for Liaison	Test Sanction
NGET	Non Embedded Customer	NGET
Transmission connected Generating Unit Embedded Large Power Station Other Non-Embedded Customer Transmission Owner Network Operator	NGET	
Embedded Medium Power Station or Embedded Small Power Station	Network Operator	

APPENDIX F

Flow Chart for IET Notification and Liaison

