

EirGrid plc

Proposed Grid Code Modifications from GCRP #22 (29th April 2009)

MPID 191: Automatic Generator Control (AGC) Term Change

1. Introduction

- 1.1 The term Secondary Frequency Regulation Systems (SFRS) is not an internationally recognised term. The term Automatic Generator Control (AGC) is a more globally understood term. EirGrid propose to replace SFRS with the term AGC throughout the Grid Code. This proposed modification is a standard language term change and it will have no material impact on the Grid Code and all associated obligations remain as is.

2. General overview of changes

- 2.1 It is proposed to remove all references to Secondary Frequency Regulation System (SFRS) and replace it with Automatic Generator Control (AGC).
- 2.2 This proposed modification occurs in the following sections of the Grid Code: the Index, Planning Conditions, Connection Conditions, and Operational Conditions.
- 2.3 In the glossary of acronyms and of definitions SFRS is removed and replaced with AGC.

3. Proposed Grid Code Modifications

It is proposed to amend the Grid Code by adding in the text in blue and by deleting the text in red strikethrough:

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~~OC4.3.6~~ ~~SECONDARY FREQUENCY REGULATION SYSTEM (SFRS)~~

OC4.3.6 AUTOMATIC GENERATOR CONTROL (AGC)

PLANNING CONDITIONS

PC.A4.3 Generator Operating Characteristics And Registered Data

Minimum requirements for generator operating conditions are specified in the **Connection Conditions**.

- * For thermal plant, provide a functional block diagram of the main plant components, showing boilers, alternators, any heat or steam supplies to other processes etc. indicate whether single shaft or separate shaft.

For each individual unit fill in the following:

Unit Number _____
Registered Capacity (MW) _____

	Symbol	Units
* Normal Maximum Continuous Generation Capacity:		MW
* Normal Maximum Continuous Export Capacity		MW
* Power Station auxiliary load		MW
§ Power Station auxiliary load		Mvar
* Maximum (Peaking) Generating Capacity		MW
* Maximum (Peaking) Export Capacity		MW
* Normal Minimum Continuous Generating Capacity		MW
* Normal Minimum Continuous Export Capacity		MW
* Generator Rating:	Mbase	MVA
* Normal Maximum Lagging Power Factor		Mvar
* Normal Maximum Leading Power Factor		Mvar
§ Governor Droop	R	
§ Forbidden zones		MW
§ Terminal Voltage adjustment range		kV
§ Short Circuit Ratio		
§ Rated Stator Current		Amps

Description		
§ Capability Chart showing full range of operating capability of the generator including thermal and excitation limits.		Diagram
§ Open Circuit Magnetisation Curves		Graph
§ Short Circuit characteristic		Graph
§ Zero power factor curve		Graph
§ V curves		Diagram
	Symbol	Units
§ Time to synchronise from warm		Hour
§ Time to synchronise from cold		Hour
§ Minimum up-time		Hour
§ Minimum down-time		Hour
§ Normal loading rate		MW / min
§ Normal deloading rate		MW / min
§ Can the generator start on each fuel		
§ Ability to change fuels on-load		
§ Available modes (lean burn, etc.)		
§ Time to change modes on-load		
§ Control range for SFRS AGC operation		MW
Other relevant operating characteristics not otherwise provided....		

CONNECTION CONDITIONS

CC.7.3 Generators

CC.7.3.1 The conditions specified in this section of the code apply to all **Generation Units** connected to or connecting to the **Transmission System**.

CC.7.3.1.1 Each **Generation Unit**, shall, as a minimum, have the following capabilities:

- (a) operate continuously at normal rated output at **Transmission System Frequencies** in the range 49.5Hz to 50.5Hz;
- (b) remain synchronised to the **Transmission System** at **Transmission System Frequencies** within the range 47.5Hz to 52.0Hz for a duration of 60 minutes;
- (c) remain synchronised to the **Transmission System** at **Transmission System Frequencies** within the range 47.0Hz to 47.5Hz for a duration of

- 20 seconds required each time the **Frequency** is below 47.5Hz;
- (d) remain synchronised to the **Transmission System** during rate of change of **Transmission System Frequency** of values up to and including 0.5 Hz per second;
 - (e) sustained operation at the specified **Minimum Generation** within the range 49.8 to 51.0 Hz;
 - (f) remain synchronised to the **Transmission System** at normal rated output at **Transmission System Voltages** within the ranges specified in CC.8.3.2 for step changes in **Transmission System Voltage** of up to 10%.
 - (g) sustained operation in accordance with the **Reactive Power** capability as required by CC.7.3.6 at **Transmission System Voltages** within the ranges specified in CC.8.3.2, unless otherwise specified;
 - (h) remain synchronised during and following **Voltage** dips at the **HV** terminals of the **Generator Transformer** of 95% of nominal **Voltage** (5% retained) for duration 0.2 seconds and **Voltage** dips of 50% of nominal **Voltage** (i.e. 50% retained) for duration of 0.6 seconds. Following the fault clearance the **Generation Unit** should return to pre-fault conditions subject to its normal **Governor Control System** and **Automatic Voltage Regulator** response;
 - (i) remain synchronised to the **Transmission System** during a negative phase sequence load unbalance in accordance with IEC 60034-1
 - (j) The short circuit ratio of each **Generation Unit** shall be in accordance with IEC 60034-1
 - (k) **Minimum Load** not greater than 50% of **Registered Capacity** for **CCGT Installations** and not greater than 35% of **Registered Capacity** for all other **Generation Units**. For **CCGT Installations** whilst operating in **Open Cycle Mode** as a result of combined cycle plant capability being unavailable, the **Minimum Load** of each **Combustion Turbine Unit** must be not greater than 35% of the **Registered Capacity** divided by the number of **Combustion Turbine Units**.
 - (l) **Ramp up capability** not less than 1.5% of **Registered Capacity** per minute when the **Unit** is in the **Normal Dispatch Condition**.
 - (m) **Ramp down capability** not less than 1.5% of **Registered Capacity** per minute when the **Unit** is in the **Normal Dispatch Condition**.
 - (n) **Minimum up-time** not greater than 4 hours for **Thermal Units**
 - (o) **Minimum down-time** not greater than 4 hours for **Thermal Units**

- (p) **Forbidden Zones** within the range between normal **Minimum Load** plus 5% and **Registered Capacity** less 10%, not more than 2 specified zones each not greater than 10% of **Registered Capacity**
- (q) **Block Loading** not greater than 10% of **Registered Capacity**
- (r) Time off-load before going into longer standby conditions remain in a hot condition for at least 12 hours and remain in a warm condition for at least 60 hours
- (s) Time to **Synchronise** (from instruction) hot : not greater than 3 hours
warm : not greater than 8 hour
cold : not greater than 12 hours
- (t) (i) Time from **Synchronising** to **Minimum Load** hot : not greater than 40 minutes
warm : not greater than 90 minutes
cold : not greater than 180 minutes
- (ii) **Time to deload from Minimum Load to De- Synchronising** not greater than 40 minutes, except where agreed with the TSO.
- (u) **Operating Reserve**
- (i) **POR** not less than 5% **Registered Capacity**
To be provided, at a minimum, at **MW Outputs** in the range from 50% to 95% **Registered Capacity**, with provision in the range of 95% to 100% **Registered Capacity** to be not less than that indicated by a straight line with unity decay from 5% of **Registered Capacity** at 95% output to 0 at 100% output.
- (ii) **SOR** not less than 5% **Registered Capacity**
To be provided, at a minimum, at **MW Outputs** in the range from 50% to 95% **Registered Capacity**, with provision in the range of 95% to 100% **Registered Capacity** to be not less than that indicated by a straight line with unity decay from 5% of **Registered Capacity** at 95% output to 0 at 100% output.
- (iii) **TOR1** not less than 8% **Registered Capacity**
To be provided, at a minimum, at **MW Outputs** in the range from 50% to 92% **Registered Capacity**, with provision in the range of 92% to 100% **Registered Capacity** to be not less

than that indicated by a straight line with unity decay from 8% of Registered Capacity at 92% output to 0 at 100% output.

- (iv) **TOR2 not less than 10% Registered Capacity**
To be provided, at a minimum, at **MW Outputs** in the range from 50% to 90% **Registered Capacity**, with provision in the range of 90% to 100% **Registered Capacity** to be not less than that indicated by a straight line with unity decay from 10% of Registered Capacity at 90% output to 0 at 100% output.
- (v) The **TSO** may request **Generation Units of Registered Capacity** greater than or equal to 60MW to have the capacity to operate under **SFRS AGC** at all loads between **SFRS AGC Minimum Load** and **SFRS AGC Maximum Load**

OPERATIONAL CONDITIONS

OC4 SYSTEM SERVICES

OC4.1 INTRODUCTION

OC4.2 SCOPE

OC4.3 FREQUENCY CONTROL

OC4.3.1 INTRODUCTION

OC4.3.2 OBJECTIVE

OC4.3.3 DESCRIPTION OF FREQUENCY CONTROL

OC4.3.4 REQUIREMENTS OF GENERATION UNIT GOVERNOR SYSTEMS

OC4.3.5 DISPATCH INSTRUCTIONS

~~**OC4.3.6 SECONDARY FREQUENCY REGULATION SYSTEM (SFRS)**~~

OC4.3.6 AUTOMATIC GENERATOR CONTROL (AGC)

~~**OC4.3.6 SECONDARY FREQUENCY REGULATION SYSTEM (SFRS)**~~

OC4.3.6 AUTOMATIC GENERATOR CONTROL (AGC)

OC4.3.6.1 The secondary **Frequency** regulation system operational on the **Transmission System** is known as the "~~Secondary Frequency Regulation System~~"-(~~SFRS~~) "**Automatic Generator Control**" (**AGC**).

OC4.3.6.2 **Generation Units** with a **Registered Capacity** of 60MW or greater are, under **Connection Conditions**, required to be connected to **SFRS AGC**, the **SFRS AGC Control Range** being a **Registered Operating Characteristic**.

- OC4.3.6.3 Other than as provided for in OC4.3.6.4 and OC4.3.6.5 all **Generation Units** fitted with **SFRS AGC** shall operate under the control of **SFRS AGC** when within their **SFRS AGC Control Range**.
- OC4.3.6.4 In the event that the **Generator** (acting in accordance with **Good Industry Practice**) considers that it is necessary to secure the reliability of a **Generation Unit**, or for the safety of personnel and/or **Plant**, to prevent a **Generation Unit** from operating under **SFRS AGC** and commences to control the MW output manually, then the **Generator** shall inform the **TSO** of this without delay. **Generators** shall also inform the **TSO** of the reasons for not operating the **Generating Unit** under **SFRS AGC**, and the course of action being taken to rectify the problem forthwith. When the problem has been rectified, the **Generator** shall contact the **TSO** to arrange for the **Generation Unit** to return to operation under the control of **SFRS AGC**.
- OC4.3.6.5 The **TSO** may issue a **Dispatch Instruction** to a **Generator** to prevent a **Generation Unit** (fitted with **SFRS AGC**) from operating under **SFRS AGC**, in accordance with **SDC2**.
- OC4.3.6.6 **Generation Units** not operating under **SFRS AGC** for reasons set out in OC4.3.6.4 and OC4.3.6.5 shall nevertheless continue to follow **MW Dispatch Instructions** as required by **SDC2**.

GLOSSARY

ACRONYMS

SFRS	Secondary Frequency Regulation System
AGC	Automatic Generator Control

DEFINITIONS

Secondary Frequency Regulation Systems (SFRS) Automatic Generator Control (AGC)	A control system installed between the NCC and a Power Station whereby MW set points can be adjusted remotely by the TSO to reflect the Dispatch Instruction
SFRS AGC Control Range	The range of loads over which SFRS AGC may be applied.
SFRS AGC Maximum Load	The upper limit of the SFRS AGC Control Range .
SFRS AGC Minimum Load	The lower limit of the SFRS AGC Control Range .

MPID 192: Secondary Fuel Testing Procedure

Introduction

On 12 January 2009, the Commission for Energy Regulation published a Decision paper on secondary fuel obligations on licensed generation capacity. The purpose of this paper was to strengthen the obligations on generators with respect to their role in relation to security of electricity supply and to introduce a remuneration mechanism for meeting some of the obligations.

General overview of changes

Following the publication of this decision paper, EirGrid is now in a position to propose changes to the Grid Code in order to put in place the necessary obligations surrounding secondary fuels. The issues addressed in this proposal include data collection, connection conditions relating to capabilities of generators on secondary fuel, if applicable, and provision of signals, definitions and testing.

Section by Section Review

Planning Code

Information that must be supplied in the planning time frame by the Generator is contained in PC.A4. Changes are necessary here for a generator unit to supply information for both primary fuel and secondary fuel and the number of available running hours at registered capacity from on-site fuel storage stocked to its full capacity.

Connection Conditions

Changes are required in this section so that generators comply with the connection conditions for both primary and secondary fuel.

Operational Conditions

EirGrid has been directed by the CER to test generators periodically on secondary fuels and the associated capability on-line fuel changeover. The proposed clauses give EirGrid the right to carry out the necessary tests and monitoring.

Glossary

Two new definitions are required in the glossary table of the Grid Code, namely Fuel Switch Over Output and Secondary Fuel.

Proposed Grid Code Modifications

It is proposed to amend the Grid Code by adding in the text in red and by deleting the text in blue strikethrough:

Planning Conditions

PC.A4.3 Generator Operating Characteristics And Registered Data

Minimum requirements for generator operating conditions are specified in the **Connection Conditions**.

- * For thermal plant, provide a functional block diagram of the main plant components, showing boilers, alternators, any heat or steam supplies to other processes etc. indicate whether single shaft or separate shaft.

For each individual unit, on **Primary Fuel** and on **Secondary Fuel**, fill in the following:

- § Unit Number:
- § **Registered Capacity** (MW):
- § **Fuel:**

	Symbol	Units
* Normal Maximum Continuous Generation Capacity:		MW
* Normal Maximum Continuous Export Capacity		MW
* Power Station auxiliary load		MW
§ Power Station auxiliary load		Mvar
* Maximum (Peaking) Generating Capacity		MW
* Maximum (Peaking) Export Capacity		MW
* Normal Minimum Continuous Generating Capacity		MW
* Normal Minimum Continuous Export Capacity		MW
* Generator Rating:	Mbase	MVA
* Normal Maximum Lagging Power Factor		Mvar
* Normal Maximum Leading Power Factor		Mvar
§ Governor Droop	R	

§ Forbidden zones	MW
§ Terminal Voltage adjustment range	kV
§ Short Circuit Ratio	
§ Rated Stator Current	Amps
* Number of available hours of running at Registered Capacity from on-site fuel storage stocked to its full capacity	

Connection Conditions

CC.12.2 Signals and indications required to be provided by **Users** will include but shall not be limited to the following:

- (a) **LV** switchgear positions pertinent to the status of each **Grid Connected Transformer** through a set of two potential free auxiliary contacts (one contact normally open and one contact normally closed when circuit breaker is open) for each circuit breaker;
 - (b) kV at transformer low **Voltage** terminals; and
 - (c) a minimum of four sets of normally open potential free auxiliary contacts in each transformer LV bay for fault indication.
- (d), (e), (f), (g) and (h) are applicable to **Generators** only*
- (d) MW and +/-Mvar at alternator terminals of each **Generation Unit**;
 - (e) kV at **Generator Transformer LV** terminals;
 - (f) **Generator Transformer** tap position;
 - (g) Measured or derived MW output on each fuel, from **Generation Units** that can continuously fire on more than one fuel simultaneously;
 - (h) Where it is agreed between the **TSO** and the **Generator** that signals are not available on the **HV** terminals, +/- **MW** and +/- **Mvar** shall be provided at the **Grid Connected Transformer** low **Voltage** terminals; and
 - (i) **Remaining Secondary Fuel** capability (where applicable) in **MWh** equivalent when running at **Registered Capacity**.
- (j) and (k) are applicable to **Demand Customers** only,
- (j) **MW** and +/- **Mvar** at the **HV** terminals of the **Grid Connected**

Transformer; and

(k) **Grid Connected Transformer** tap position.

(l), (m) and (n) are applicable to **Dispatchable Demand Customers** who represent a **Demand Side Unit** which consists on an **Individual Demand Site**:

(l) MW and Mvar +/- at alternator terminals of each **Generator** where applicable;

(m) Measured or derived **MW Output** for each **Generator** at the **HV** terminals of the **Grid Connected Transformer**; and

(n) **Demand Reduction** aggregated at the **HV** terminals of the **Grid Connected Transformer**.

(o), (p) (q) and (r) are applicable to **Dispatchable Demand Customers** who represent a **Demand Side Unit** which consists on an **Aggregated Demand Site**:

(o) The aggregated MW and +/- Mvar aggregated at alternator terminals of each **Generator** where applicable;

(p) Where requested by the **TSO**, the MW and Mvar of each **Individual Demand Site** at the alternator terminals of each **Generator** where applicable;

(q) The aggregated, measured or derived MW output for each **Generator**, aggregated at the **HV** terminals of the **Grid Connected Transformer** where applicable: and

(r) The aggregated **Demand Reduction** aggregated at the **HV** terminals of the **Grid Connected Transformer**.

Operating Conditions

OC10.2.2 In order to achieve the primary objective set out in OC10.2.1, OC10 establishes procedures for **Monitoring, Testing and Investigation**. In particular, this facilitates adequate assessment of each of the following:

(a) whether **Centrally Dispatched Generation Units (CDGU)** and **Demand Side Units** comply with **Dispatch Instructions**;

(b) whether **Generators, Dispatchable Demand Customers** and **Generator Aggregators** are in compliance with **Declarations of Availability, Ancillary Services** capabilities, **Operating**

Characteristics and any other data required to be registered by those **Generators, Dispatchable Demand Customers** and **Demand Side Unit Aggregators** under the **Grid Code**;

- (c) whether **Power Quality** of **Users** conforms with International Electro technical Commission Standards: 'Electromagnetic Compatibility-Limits-Limitation of emission of harmonic currents for equipment connected to medium and high voltage power supply systems [IEC/TR3 61000-3-6] and 'Electromagnetic Compatibility-Limits-Limitation of voltage fluctuation and flicker for equipment connected to medium and high voltage power supply systems ' [IEC/TR3 61000-3-7]; ~~and~~
- (d) whether **Users** are in compliance with protection requirements and protection settings under the **Grid Code, Users' Connection Agreements, Ancillary Service Agreements** and **System Support Agreements** between **Users** and the **TSO**; ~~and~~
- (e) whether **Generators** have the ability to generate on **Secondary Fuel** (where applicable) and have the ability to carry out on on-line fuel changeover at **Fuel Switch Over Output**.

OC10.4.4 Performance parameters that the **TSO** shall **Monitor** may include, but are not limited to, the following:

OC10.4.4.1 compliance with **Dispatch Instructions**;

OC10.4.4.2 compliance with **Declarations** including, without limitation, in respect of:

- (a) **Primary, Secondary** and **Tertiary Operating Reserve** provided by each of a **Generator's Generation Units**, following a low **Frequency Event** on the **Transmission System**;
- (b) **Frequency Regulation** provided by each **Generation Unit** (to confirm that it is consistent with the **Declared Governor Droop**); ~~and~~
- (c) Tertiary Operating Reserve 2 and Replacement Reserve provided by each of a Generator's Generation Units.

OC10.4.4.3 Compliance with **IEC Power Quality** standards; ~~and~~

OC10.4.4.4 Provision of static and dynamic **Reactive Power**; ~~and~~

OC10.4.4.5 Monitoring of **Primary Fuel** and **Secondary Fuel** capability, on-line changeover capability and fuel storage levels.

OC10.5.5 The **TSO** may, from time to time, carry out **Tests** in order to determine that a **User** is complying with its **Connection Conditions, Registered Operating Characteristics** and **Declarations**. The **TSO** may:

- (a) from time to time and for the purposes of **Testing**, issue a **Dispatch Instruction**;
- (b) induce controlled **Power System Frequency** or **Voltage** conditions or variations for the purpose of determining that the **Generation Unit's** response is in accordance with its **Declared Availability, Ancillary Service** capabilities and **Operating Characteristics**; and
- (c) having given three **Business Days** notice, or less where agreed, (identifying the **Ancillary Service** and/or **Operating Characteristic** to be tested), send a representative to the **Generator's Site** to verify by **Testing** in accordance with the **Test** procedures specified in OC10.5.8, that the **Generator** is in compliance with its **Declared** values; and
- (d) request **Start-Up on Secondary Fuel**, or on-line changeover **at Fuel Switch Over Output** from **Primary Fuel to Secondary Fuel** or from **Secondary Fuel to Primary Fuel**, where applicable.

Glossary

Two new definitions are required in the glossary table of the Grid Code.

Fuel Switch Over Output The **MW** output, not lower than **Minimum Load** at which a **Generation Unit** can achieve a switch over from **Primary Fuel** to **Secondary Fuel** or from **Secondary Fuel** to **Primary Fuel**.

Secondary Fuel The fuel or fuels registered in accordance with the **Grid Code** as the secondary or back-up fuel(s) authorised for **Energy** production by the **Generation Unit**.

