

# EirGrid Grid Code SCU Implementation

Response to Industry Feedback

Published 26<sup>th</sup> July 2024



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Revision History						
Revision	Date	Description	Originator	Reviewer	Checker	Approver

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# 1 Background

An Implementation Note for Synchronous Condenser Units (SCUs) was published by SONI and EirGrid in October 2022 to offer guidance to those planning to connect SCUs in order to provide system services within Ireland and Northern Ireland, specifically in relation to the application of Grid Codes within both jurisdictions. This Implementation Note did not propose any Grid Code modifications at the time but allowed for the submission of stakeholder feedback on its contents with the intention of implementing SCUs into the Grid Codes in the future.

On 20<sup>th</sup> March 2024, the incorporation of Synchronous Condenser Units (SCUs) into the Grid Codes as a new User type was brought as a discussion item to the SONI and EirGrid Joint Grid Code Review Panel Meeting (JGCRP). A draft red-line and green-line version of both the SONI and EirGrid Grid Codes was circulated to JGCRP members post this meeting, and members were asked to submit feedback on the documentation by 3rd May 2024. This document is a response to the feedback received from members with respect to the proposed EirGrid Grid Code modification.

Feedback of a confidential nature has not been included in this document, and instead will be addressed on an individual basis.

## 2 Responses to Industry Feedback

### 2.1 General Conditions Section

- GC.9.6.2.1

Industry Feedback:
<p><i>"The criteria specified by CRU to assess derogations pursuant to GC.9.6.3 and GC.9.6.4 are specified in form [TO BE PUBLISHED BY TSO]."</i></p> <p>Criteria needs to be published.</p>
EirGrid Response:
<p>Agreed, the criteria has now been included in form GC9-1 NON Network Code Plant, BESS or SCU Derogation Application Form, and is accessible via the EirGrid website <a href="#">here</a>.</p>

### 2.2 Scheduling & Dispatch Code 1 Section

- SDC1.4.3.6

Industry Feedback:
<p><i>Increasing Availability for SCUs:</i> text should be modified to say that increasing Availability, in the case of an SCU, indicates that the SCU is capable of synchronising to the system, increasing its lagging MVar output, or reducing its leading MVar absorption.</p> <p><i>Decreasing Availability for SCUs:</i> text should be modified to say that decreasing Availability, in the case of an SCU, indicates that the SCU is capable of being synchronised to the system, or operating with reduced MVar output, or operating with increased MVar absorption.</p>

#### **EirGrid Response:**

For SCUs, Availability Notices will be in Active Power (MW) only. SCUs will not submit Reactive Power profiles. For SCUs, Availability will go from 0 MW to some negative MW value, indicating consumption of MW, as SCUs will consume MW in order to provide inertia.

## 2.3 Scheduling & Dispatch Code 2 Section

- SDC2.4.2.3

#### **Industry Feedback:**

*A Synchronous Condenser cannot provide Operating Reserve.*

#### **EirGrid Response:**

Agreed, this clause will be listed in the exclusions for SCUs in the next draft of this modification.

- SDC2.4.2.4 (b)(i)

#### **Industry Feedback:**

-) *"Voltage levels (at instructed MW level) at the Connection Point which will be maintained by the CDGU or Synchronous Condenser Unit."* -> SynCon MW level is -0MW. This could be changed to

*"...or Voltage levels at the Connection Point which will be maintained by the CDGU (at instructed MW level) or Synchronous Condenser Unit"*

#### **EirGrid Response:**

As SCUs need to consume MW in order to provide inertia, they will be dispatched to a negative MW value, indicating consumption of MW. An SCU MW level of 0 MW indicates that the SCU is "off". An SCU instructed to a negative MW level is consuming MW, and so is "on". We recommend maintaining the original wording suggested, as SCUs will be dispatched, i.e. instructed on at a specified MW level.

- SDC2.4.2.12

#### **Industry Feedback:**

The text referenced here is in relation to Non-RfG Units i.e. connected to the Network on or before 30th Nov. 2018 or had a contract signed for the purchase of the main plant on or before 30th Nov. 2018. It would therefore be extremely unlikely to be applicable for Synchronous Condensers.

#### **EirGrid Response:**

Agreed, this text will be copied out separately for SCUs in the next draft of this modification.

- SDC2 Appendix A Title

Industry Feedback:
Title should be changed to <i>"Dispatch Instructions for CDGUs, Synchronous Condenser Units and Demand Side Units"</i>
EirGrid Response:
Agreed, this change will be implemented into the next draft of this modification.

- SDC2.B.4 - SDC2.B.7

Industry Feedback:
<p>1kV@220kV means an accuracy of 0.4545%. That would be extremely challenge, possibly requiring smaller tap size and additional number of taps (leading to an impracticable transformer design). A reasonable tap size of 1.5% would equal to 3.3kV and a tap size of 1.25% to 2.5kV.</p> <p>Additionally, the voltage control strategy should be discussed in more detail, because a target voltage would be reached by adjusting the reactive power (via the AVR). The actual tap position would be changed to maintain the operation of the SynCon within its terminal voltage limits.</p> <p>Note that SDC2.B.6 describes that under high system voltage maximum MVar absorption may be given. Another supporting point that the requirement of exporting of MVar (over-excited operation) under high system voltage would contradict voltage control in the grid. In addition SDC2.B.7: operation in constant terminal voltage mode, unless otherwise agreed</p>
EirGrid Response:
<p>Voltage setpoints are issued to a whole kV value and SCUs would be expected to achieve that whole kV value. This should be achieved by using a tap changer for coarse voltage control, and then utilising the reactive power capability of the SCU to bring the voltage to within the reactive power target value at the generator terminals. Both should be used together to achieve the voltage setpoint. Achieving the voltage setpoint within a tolerance of 3 kV for 220 kV, as suggested by industry, is not desirable, and we maintain that SCUs must achieve the specified target voltage within a tolerance of 1 kV at 220kV.</p>

- SDC2.B.17

Industry Feedback:
<p>"Action should not be 'limited' in situation that is dangerous to personnel or Plant. 'limited' should be removed. Below wording from SDC2.4.2.4 (iii) should be used here also, namely:</p> <p><i>"A Generator or Synchronous Condenser Unit Operator may take such action as is in its reasonable opinion necessary to avoid an imminent risk of injury to persons or material damage to property (including the CDGU or Synchronous Condenser Unit)."</i></p>
EirGrid Response:
Agreed, this change will be implemented into the next draft of this modification.

## 2.4 SCU Section

- SCU1.1

Industry Feedback:
Suggest to modify the 2nd paragraph to read as follows: <i>"Transmission Connected Synchronous Condensers Units will be subject to Grid Code Compliance testing as applicable to the technology at the discretion of the TSO".</i>
EirGrid Response:
All Grid Code requirements are as applicable to the technology. Therefore, we feel there is no need to explicitly specify this here.

- SCU1.4.1 (f) and SCU1.4.4 (b)

Industry Feedback:
See SCU1.4.4 (b) below for comment relating to voltages. kV needs to be consistent. 360 kV is better than 350 kV (360kV is -10% and is more appropriate). 198 kV or 200 kV not as material.
EirGrid Response:
SCU1.4.1 (f) refers to the minimum required capability of an SCU to remain synchronised to the Transmission System and operate within the ranges of the Transmission System Voltage at the connection point, for an unlimited time period. SCU1.4.4 (b), which refers to CC.8.3.2, is informing Users of the Transmission System Voltages during disturbances and faults specifically.

- SCU1.4.2

Industry Feedback:
<i>"quick re-synchronisation"</i> is ambiguous. Suggest this is ammended to <i>"..shall be capable of re-synchronisation within a timeframe as agreed between the TSO and the Synchronous Condenser Unit"</i> .
EirGrid Response:
Agreed, this change will be implemented into the next draft of this modification.

- SCU1.4.3

Industry Feedback:
Why synchronise across the HV Circuit Breaker as the Synchronous Condenser cannot trip to House Load?

**EirGrid Response:**

This clause includes the phrase “which may include”, and so does not require an SCU to synchronise across the HV circuit breaker. However, it does provide the TSO flexibility to synchronise across the HV circuit breaker, for example, in a situation where there is a rural or back up feed into the SCU.

- **SCU1.4.4**

**Industry Feedback:**

Synchronising between 47 to 47.5 Hz only has a 20 sec operational requirement. Very unlikely that the system frequency will have changed from 47 hz to above 47.5 hz in 20 sec. Therefore why is this requirement necessary?

**EirGrid Response:**

Although this scenario may be unlikely, it is a potential risk. As such, it is necessary for the TSO to have procedures in place, and for Users to have capabilities available to the system, to address this risk. If a User has been instructed to synchronise 15 minutes before a frequency nadir below 47.5 Hz, the User would still be expected to synchronise in order to provide momentum and voltage support to the system and to assist in stabilising the frequency.

- **SCU1.4.5**

**Industry Feedback:**

Request Eirgrid to provide more detail and clarity on “*Common Mode Failure*” and this clause so there is no misunderstanding.

**EirGrid Response:**

Per the IEC 60050 - International Electrotechnical Vocabulary, a common mode failure is: failure of items characterised by the same manner of failure. NOTE - Common mode failures should not be confused with common cause failures, as the common mode failures can result from different causes.

Using a protection scheme example, a common mode failure would be if you had duplicated protection schemes on a power plant/transmission line that were from the same manufacturer/vendor. Say then that there exists a previously unknown software or hardware defect in the protection relays. As both schemes/relays are identical, this would be a common mode failure.

A way to mitigate this common mode failure is that the protection schemes are implemented using 2 x separate manufacturers/vendors so that the failure of one relay/scheme does not result in the total loss of protection for the plant. This mitigation would be standard across many utilities (including ESB and EirGrid, for distribution and transmission system protection schemes).

- SCU1.4.6.1

Industry Feedback:
<p>1) "Each Synchronous Condenser Unit shall have the following Reactive Power capability as measured at the terminals and the Connection Point" should be " Each Synchronous Condenser Unit shall have the following Reactive Power capability as measured at the <del>terminals and the</del> Connection Point"</p> <p>2) The 400 kV and 220 kV voltage ranges are different in SCU1.4.6.1 than in SCU1.4.1(f). Which is correct?</p> <p>3) Synchronous Condensers cannot provide Active Power (MW) only Reactive Power (MVar). Therefore a Synchronous Condenser cannot maintain a MW level as intended in this clause. It does have a constant MW demand but that does not seem the intention of the clause. Clause to be reworded.</p> <p>4) "Reactive Power capability at the Connection Point (Ratio of MVar to MVA rating of the Synchronous Condenser Unit:" should be "Minimum Reactive Power capability at the Connection Point (Ratio of MVar to MVA rating of the Synchronous Condenser Unit:"</p>
EirGrid Response:
<p>1) Agreed, this change will be implemented into the next draft of this modification.</p> <p>2) SCU1.4.6.1 states the voltage ranges over which SCUs must provide the required Reactive Power capability. SCU1.4.1 (f) states the voltages ranges over which SCUs must remain synchronised to the Transmission System and operate for an unlimited time period.</p> <p>3) This clause is intended to mean at the constant MW demand level it was scheduled to. SCUs will be dispatched to a negative MW level to indicate consumption of MW.</p> <p>4) All Grid Code requirements are the minimum requirements a User must adhere to. Therefore, we feel there is no need to explicitly specify "minimum" here.</p>

- SCU1.4.6.2

Industry Feedback:
<p>1) "... over the full range of Transmission System Voltages". Please explain why injection of reactive power is required during transmission system high voltage conditions? Equally, why is absorption of reactive power is required during transmission system low voltage conditions? We recommend that these regions are clipped (see tab "Reactive Power Capability" for more information).</p> <p>2) 220kV voltage range in graph under SCU1.4.6.2 does not match 220kV voltage range under SCU 1.4.1 (1.118 vs 1.114). Please clarify.</p>
EirGrid Response:
<p>1) The TSO may take proactive actions to drive up or down voltage based on upcoming actions on the transmission system, for example, increasing voltage before disconnecting another device.</p> <p>2) Agreed, this change will be implemented into the next draft of this modification.</p>



- SCU1.4.6.3

Industry Feedback:
<p>1) Typo: Change the word "with" to "within".</p> <p>2) Note: MVAR changes are carried out by tapping the GSUT so for more than one tap change then a short time is needed for stabilisation after each tap. This is also referenced elsewhere in the grid code. TSO to take into account timeline is controlled by actions of NCC and should be agreed.</p> <p>3) Would be better if the text under both graphs was as adjusted to the left so the Q/MVA was under the vertical voltage line.</p>
EirGrid Response:
<p>1) Agreed, this will be corrected in the next draft of this modification.</p> <p>2) Thank you for the comment. Note that this is part of EirGrid's normal tap changing processes.</p> <p>3) Agreed, this will be corrected in the next draft of this modification.</p>

- SCU1.4.6.4

Industry Feedback:
<p>This section refers back to CC.7.3.6.6 which in turn refers back to CC.7.3. Please verify relevance to SCUs as Power Factor is at or near zero, and remove reference/clause accordingly?</p>
EirGrid Response:
<p>SCU1.4.6.4 does not refer back to CC.7.3.6.6. SCU1.4.6.4 states that <i>The TSO and the Synchronous Condenser Unit Operator will liaise on matters related to SCU1.4.6 at the design stage.</i></p>

- SCU1.4.7.4

Industry Feedback:
<p>1) This clause is not achievable for SCUs. 5 seconds is typically required for settling times for voltage setpoint changes.</p> <p>2) "The response may require a transition from maximum Mvar production to maximum Mvar absorption or vice-versa." would be caused by extreme changes in transmission system voltage. For more information, see 'AVR Speed of Response' tab for reference in other grid codes.</p>
EirGrid Response:
<p>1) Agreed, this clause will be updated to reflect a settling time of 5 seconds.</p> <p>2) Comment acknowledged.</p>

- SCU1.6.5 and SCU1.6.6

Industry Feedback:
Remove references to User(s) and replace with "Synchronous Condenser Units" to remove ambiguity.
EirGrid Response:
The term "User" is defined in the Grid Code as " <i>A term utilised in various sections of the Grid Code to refer to the persons using the Transmission System, <u>as more particularly identified in each section of the Grid Code concerned</u>. The term means any person (other than the TSO) to whom the Grid Code applies</i> ". In SCU1.6.5 and SCU1.6.6, the term "User" is synonymous with SCUs. This practice is used throughout the Grid Code, and therefore we feel there is no need to remove the term here.

- SCU1.7.1.1

Industry Feedback:
1) Clause (f) - 120 business days is not sufficient. 18 months would be appropriate. 2) Item (e)i - Typo: Replace "Code" with "Mode".
EirGrid Response:
1) This is an existing Grid Code requirement that applies to other Grid Code users and will also apply to SCUs. The requirement states "... <u>at least</u> 120 Business Days", and so does not prohibit earlier engagement where required. However, EirGrid will take an action to review the appropriateness of this requirement for all Users, which may drive a separate Grid Code modification in the future.  2) Agreed, this typo will be corrected in the next draft of this modification.

- SCU1.7.2.3

Industry Feedback:
What is the purpose of this clause? If the TSO sends a signal/command, then it doesn't matter to the Synchronous Condenser whether it is received within 1 second or 100 seconds, it would be acted on when it was received. Provider has no control over relay time from NCC. This is a statement of TSO requirement - needs to be clarified that this is not a provider requirement. The accuracy of any analogue signals would obviously be important (i.e. the 0.5%)
EirGrid Response:
The Grid Code contains requirements for Transmission System Users and for the TSO. This is a requirement for the TSO, and also provides Users with relevant information about how digital output commands will be relayed to them by the TSO.

- SCU1.7.3

Industry Feedback:
<p>1) Why are PPMs referenced in the Synchronous Condenser section?</p> <p>2) If the Responsible Operator was in the ROC (Renewable Operation Centre - F27), then this person would not be able to attend site within one hour. Either remove this part of the clause or modify the text to "Responsible Operator or their designate".</p>
EirGrid Response:
<p>1) The PPM reference is a typo. Reference to PPMs here will be removed in the next draft of this modification.</p> <p>2) This is an existing requirement for other Grid Code users that we feel is also appropriate for SCUs. The designate should also be a Responsible Operator, so we feel there is no need to modify this text.</p>

- SCU1.7.4.2

Industry Feedback:
120 business days is not sufficient. 18 months would be appropriate.
EirGrid Response:
<p>This is an existing Grid Code requirement that applies to other Grid Code users and will also apply to SCUs. The requirement states "... <u>at least</u> 120 Business Days", and so does not prohibit earlier engagement where required. However, EirGrid will take an action to review the appropriateness of this requirement for all Users, which may drive a separate Grid Code modification in the future.</p>

## 2.5 Definitions Section

- Availability definition

Industry Feedback:
<p>In terms of MW, a Synchronous Condenser is just a load on the system, no different from any other consumer.</p> <p>"Availability" in relation to a Synchronous Condenser is really the quantity of Reactive Power it can import or export from the connection point. It cannot produce Active Power.</p> <p>Suggest to modify the description accordingly.</p> <p>Please clarify relevance of definition of 'Availability' for SCUs based on available active power import.</p>
EirGrid Response:
<p>The draft modification defines a Synchronous Condenser Unit (SCU) as "A <i>synchronous machine designed to operate as a motor with no prime mover providing Synchronous Compensation and</i></p>

*zero Active Power Generation but with non-zero Active Power Demand*". Where we use the term *MW Output* to refer to the Active Power output of a Generation Unit, we will use the term *Active Power Demand* to refer to the MW consumption of an SCU.

For Generation Units, Availability goes from 0 MW to some positive MW value, indicating generation of MW.

For SCUs, Availability will go from 0 MW to some negative MW value, indicating consumption of MW, as SCUs will consume MW in order to provide inertia. As SCUs will be instructed on, they will need to submit negative Physical Notifications to reflect this.

- *MVAr Output* definition

**Industry Feedback:**

A Synchronous Condenser produces and absorbs Reactive Power exactly the same way as a normal generator. Therefore the definition should be exactly the same.

Suggest to modify the definition of a Synchronous Condenser MVAr Output to be identical to that of a generator."

**EirGrid Response:**

Under this proposed Grid Code modification, Mvar Output is defined as "*The Reactive Power produced or absorbed by a Generation Unit net of Generation Unit Auxiliary Load or in the case of a Synchronous Condenser Unit the actual Reactive Power output in Mvar at the Connection Point.*" Mvar Output is measured at the Connection Point for SCUs, and at the alternator terminals for Generation Units.

## 3 Next Steps

This feedback document will be circulated to relevant industry representatives on Friday 26<sup>th</sup> July 2024, and industry will be requested to provide any additional feedback by Friday 16<sup>th</sup> August.

A revised proposed modification incorporating any feedback as indicated will be presented at the Grid Code Review Panel meeting in September 2024.