ESO

Workgroup Consultation

GC0154:

Incorporation of interconnector ramping requirements into the Grid Code as per SOGL Article 119

Overview: This modification seeks to codify ramping requirements for interconnectors into the Grid Code

Modification process & timetable

1. **Proposal Form**
   01 July 2022
2. **Workgroup Consultation**
   11 July 2023 - 03 August 2023
3. **Workgroup Report**
   20 September 2023
4. **Code Administrator Consultation**
   02 October 2023 - 02 November 2023
5. **Draft Modification Report**
   15 November 2023
6. **Final Modification Report**
   07 December 2023
7. **Implementation**
   TBC

Have 5 minutes? Read our Executive summary

Have 20 minutes? Read the full Workgroup Consultation

Have 30 minutes? Read the full Workgroup Consultation and Annexes.

Status summary: The Workgroup are seeking your views on the work completed to date to form the final solution(s) to the issue raised.

This modification is expected to have a: High impact on interconnectors as the relevant SOGL Article refers to the HVDC interconnector ramping restrictions for active power.

Modification drivers: This modification is driven by EU Compliance and direction from Ofgem. The Compliance is in line with SOGL Article 119 1 (c) as retained in UK Law under SI 2019, no. 533.

Governance route	This modification will be assessed by a Workgroup and Ofgem make the decision on whether it should be implemented	
Who can I talk to about the change?	**Proposer:** Louise Trodden, ESO Louise.trodden@nationalgrideso.com Phone: 07866 165538	**Code Administrator Chair**: Catia Ariana Gomes catia.gomes@nationalgrideso.com Phone: 07843 816580
How do I respond?	Send your response proforma to grid.code@nationalgrideso.com **by 5pm on 03 August 2023**	

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Executive summary

The System Operator Guideline (SOGL) is one of the European Network Codes that has been retained in British law following the European Union exit. Currently interconnector ramping arrangements are detailed within individual Operating agreements held between the Electricity System Operator (ESO), the Interconnector Owner and the connected Transmission System Operator (TSO). Ofgem recognise arrangements are in place for ramping to suit the requirements of SOGL, however, requested for ramping arrangements to be included in the Grid Code for clarity to all parties (including future connecting interconnectors).

What is the issue?

The System Operator Guideline (SOGL) is one of the European Network Codes that has been retained in British law following the EU-exit. SOGL Article 119 required NGESO as the responsible GB Transmission System Operator (TSO) to write and have approved by Ofgem, operational methodology texts which included ramping arrangements for the active power output on High Voltage Direct Current (HVDC) interconnectors. This included an LFC Block Operational Agreement (which covers A119 and is here with an accompanying supporting document here).

The methodology texts were submitted to Ofgem and approved however, Ofgem in their Decision Letter[1] set out that interconnector ramping arrangements should be incorporated into the Grid Code to allow clarity for stakeholders.
It is NGESO's intention in this modification to address the need to set out provisions for interconnector ramping into the Grid Code as instructed.

What is the solution and when will it come into effect?

Proposer's solution: The proposer recommends a standard 50MW/min ramping limit for HVDC interconnectors. This is based on a Cost Based Analysis undertaken by Baringa. This option proposes to reduce balancing costs by £865m over the study period (2023-2030) to the GB consumer and reduces the impact to security of supply as a result of unforeseen fast simultaneous interconnector ramping.

This ramping arrangement will be applicable to all existing interconnectors in service, those, currently in construction/scoping, and future connected interconnectors.

Implementation date: The proposed implementation date is 10 days after approval by the Authority.

Summary of potential alternative solution(s) and implementation date(s):
Alternative 1 was raised to the proposed maximum ramp rate of 100MW/min. This reflecs the existing maximum ramp-rate as already detailed in the current operational agreements within the Grid Code and the ESO and interconnectors whilst exploring flexible responses to cumulative ramping within the clarity this provides. This also reflects Ofgem's expectation, as set out in its 2019 approval decision noted above, that the codification process would not 'constitute a change to existing GB requirements'. The Alternative Proposer felt that the balancing cost indicated by the Origional Proposor were not proven was not supportive of the solution and CBA carried out.

What is the impact if this change is made?

The Proposer anticipated that the proposed changes will have a positive impact on interconnectors, allowing them to follow their commercial reference programmes; reduction of balancing costs incured as a result of fast simultaneous ramping; and aid overall operability and system security.

Interactions

This modification (both Proposal and WAGCM1) address a required change as driven by SOGL, which is a European Network Code. There is the possibility that this modification will need to follow the EBR Article 18 approach due to possible changes to the Balancing Code. The Workgroup should consider if there are any EBGL implications.

What is the issue?

The System Operator Guideline (SOGL) is one of the European Network Codes that has been retained in British law following the EU-exit. SOGL Article 119 required NGESO as the responsible GB Transmission System Operator (TSO) to write and have approved by Ofgem, operational methodology texts which included ramping arrangements for the active power output on High Voltage Direct Current (HVDC) interconnectors. This included an LFC Block Operational Agreement (which covers A119 and is here with an accompanying supporting document here). Additionally, with increased interconnection there are operational challenges that need to be addressed to ensure security of supply as a result of fast simultaneous interconnector ramping, alongside reducing the impacts to GB consumers with increased balancing costs.

The methodology texts were submitted to Ofgem and approved however, Ofgem in their Decision Letter[1] set out that interconnector ramping arrangements should be incorporated into the Grid Code to allow clarity for stakeholders. (Ofgem states in their decision letter that '*the intermediate methodology is designed so that obligations detailed within its articles will be incorporated within the Grid Code or NETS SQSS, thus providing an opportunity, if necessary, to add further details*.')
It is NGESO's intention in this modification to address the need to set out provisions for interconnector ramping into the Grid Code as instructed.

Why change?

Ramp rate limits are currently specified in BC1.A.1.1 of the Grid Code, but only apply to Balancing Mechanism Units (BMUs) and therefore Balancing Mechanism participants. This section demonstrates compliance to Article 137 (4). Interconnector ramp rate limits are not therefore covered in the same way as generators. Currently, ramp rates applicable to interconnectors are specified within respective tri-lateral agreements (the Interconnector Operating Protocols). Such agreements are between the two connected System Operators and the Interconnector Operator. To fulfil the requirements of Ofgem's decision letter and the obligations in Article 137 (3), a solution is required to incorporate interconnector ramping in the Grid Code.
Currently, interconnector ramping limits in GB have been set by a historic precedent in bilateral connection agreement at 100MW/minute, however these rates are no longer operationally feasible. It is expected in 2032 that there will be seven interconnectors connecting Great Britain (GB) to European Union (EU) markets. This could represent a maximum combined ramp rate of 700MW/min and (when considering full import to export) an interconnector profile change of up to 13GW as defined within a settlement period once adopted into the standard form used for BMUs. NGESO often encounters scenarios where cross border markets react to the same price signals simultaneously, leading to rapid changes in interconnector flow and frequency deviations. Additionally, interconnectors' final positions are typically only confirmed 65-70 minutes prior to real time. This highlights that a change needs to be considered to ensure that system security measures can be appropriately controlled and accessed ahead of time and that the right balance is struck between operational flexibility, efficient functioning of cross-border energy markets of which Interconnectors are key facilitators, and cost to consumers.

[1] https://www.ofgem.gov.uk/sites/default/files/docs/2019/08/article_118_and_119_final_decision.pdf

Background and history of work to date

On 14 September 2017, Ofgem published a decision which assigned obligations in Article 119 of SOGL to NGESO.

Within the Article 119 proposals, there are some sections which specifically require approval from the Authority. They are:

(c) ramping restrictions for active power output in accordance with Article 137(3) and (4)[2]

(h) the Frequency Restoration Reserve (FRR) *dimensioning rules defined in accordance with Article 157(1).*

(q) coordination actions aiming to reduce Frequency Restoration Control Error (FRCE) and defined in Article 152(14).

(r) measures to reduce the FRCE by requiring changes in the active power production or consumption of power generating modules and demand units in accordance with Article 152(6).

A full review of all obligations took place and led to submission of mapping documents and intermediate methodologies to Ofgem in 2019. The mapping included the SOGL obligations which were already covered in the relevant GB codes (the Grid Code NETS SQSS). This was inclusive of articles (h), (q) and (r), mentioned above. These articles have been acknowledged by Ofgem as meeting the provisions set out within the Article. The Intermediate GB LFC Block Operational Methodologies[3] were developed to outline the remaining obligations not covered by the GB codes. A supporting document[4] was also developed to accompany the methodology text.

Ofgem approved the intermediate methodology in August 2019, acknowledging that most obligations mapped to the Grid Code and NETS SQSS covered most of the requirements within 119, but outlined necessary steps that must be taken to ensure full compliance. In order to provide clarity to stakeholder requirements, Ofgem's Decision Letter[5] requests NGESO to publish the intermediate methodologies (in accordance with Article 8(1) of SOGL) until mapping to the Grid Code and the NETS SQSS is completed for the outstanding areas. The expectation was also that the ESO would expedite this work.
The remaining obligation refers to item (c). Whilst the approved methodology highlights that NGESO has the right to agree common ramping arrangements with interconnectors and EU TSOs, further work is required to set this out within the GB frameworks. This will allow development of a solution to enable ramping arrangements for active power output of each HVDC interconnector to be mapped to the Grid Code within Balancing Code 1 (BC1), and the accompanying Annex of this section of the code.

Since the publication of the decision in August 2019, GB has left the EU. A set of Statutory Instruments (SI)[6] were published, including The Electricity Network Codes and Guidelines (System Operation and Connection) (amendment etc.) (EU Exit) Regulations 2019. This SI has been reviewed against the pre-EU exit SOGL European Network Code (which

[2] Article 119 within the SI removes the reference to article 137 (3), however, 137 (3) is retained in GB law. NGESO has discussed this inconsistency with BEIS and we have clarity that this a discrepancy in the legislation which will be updated at an appropriate time.

[3] https://www.nationalgrideso.com/document/127201/download

[4] https://www.nationalgrideso.com/document/127196/download

[5] https://www.ofgem.gov.uk/sites/default/files/docs/2019/08/article_118_and_119_final_decision.pdf

6 Statutory Instruments (SIs) are a form of legislation which allow the provisions of an Act of Parliament to be subsequently brought into force or altered without Parliament having to pass a new Act.

originally placed requirements on NGESO through articles mentioned in this proposal paper). This review was carried out to assess whether the obligations are still relevant and retained in GB law. The review confirmed that the only outstanding SOGL reference which requires mapping and subsequent implementation to the codes is:
A119 (c) ramping restrictions for active power output in accordance with Article 137(3) and (4).

The Grid Code already specifies ramping rates for power generating modules and/demand units within BC1 demonstrating compliance for Article 137 (4). It is important to note this modification is only seeking to address Article 137 (3) (as detailed below)
3. All connecting TSOs of an HVDC interconnector shall have the right to determine in the LFC block operational agreement common restrictions for the active power output of that HVDC interconnector to limit its influence on the fulfilment of the FRCE target parameter of the connected LFC blocks by agreeing on ramping periods and/or maximum ramping rates for this HVDC interconnector. Those common restrictions shall not apply for imbalance netting, frequency coupling as well as cross-border activation of FRR and RR over HVDC interconnectors. All TSOs of the GB synchronous area shall coordinate these measures within the synchronous area.

To comply with the outstanding requirements of SOGL Article 119, a code change is required. This will allow the ESO to implement and map the outstanding approved methodologies (referred to above) within the relevant codes as directed by Ofgem. This will be done through agreeing and defining interconnector ramping and appropriately incorporating it into the Grid Code.

What is the solution?

Proposer's solution

The requirements of SOGL Article 119 (c) refer to the ramping restrictions on active power output of each HVDC interconnector. To address this and be fully compliant, the Proposer suggests all existing and new GB interconnector ramping requirements are included in the Grid Code.

The Proposer initially suggested a range of possible solutions which could be developed with industry stakeholders within the Workgroup.

Following the CBA completed by Baringa, the proposer recommends a static 50MW/min ramping limit for HVDC interconnectors. This is based on analysis undertaken by Baringa.

Reducing interconnector ramping to a static 50MW/min limit presented the largest cost saving in balancing costs in the Baringa study, this option proposes to reduce balancing costs by £865m to GB consumers over the study period (2023-2030), however Workgroup couldn't verify the cost due to limited information provided by Baringa. This option is also the least cost option so that the impact of implementation is not passed onto consumers. The lower ramping rate will also allow the control room more focus on economic despatch and daily actions to manage the system, rather than managing fast simultaneous ramping from interconnectors, therefore benefiting security of supply.

To meet the requirements of SOGL, this ramping arrangement will be applicable to all existing interconnectors, currently in construction/scoping and future connected interconnectors.

This solution meets the compliance requirements detailed in SOGL and can be included into the Grid Code as per Ofgem's request.

Workgroup considerations

The Workgroup convened 14 times to discuss the perceived issue, detail the scope of the proposed defect, devise potential solutions, and assess the proposal in terms of the Applicable Code Objectives.

The discussion within the meetings to date has centred on the following topics

Compliance to SOGL
The ESO shared the requirement from SOGL, and the subsequent letter based on the methodologies approved by the regulator to include ramping arrangements for interconnectors into the Grid Code. There were no objections or concerns raised regarding this.

Operational and economic analysis/drivers
The ESO has shared to the Workgroup several examples of the impacts of fast simultaneous ramping. The analysis shared highlighted that when interconnectors react to market signals the rate in which the flow is reversed causes a change in energy. Data was presented to demonstrate that the size of this change has increased with the increase of interconnectors to the network. The Workgroup also noted other contributory factors such as recovery from the Covid period- intermittent generator forecast, demand forecast and the ramping of a range of other types of generation assets all active at these times.

Indicative examples were shared with the Workgroup by NGESO in an effort to demonstrate the costs of the actions taken in the control room to manage the system when large simultaneous ramping occurs. Some Workgroup members expressed concern that these were specific, individual examples and requested a broader, more comprehensive assessment of the nature of the operational challenge raised by NGESO, e.g., confirmation of the proportion of total 2022 balancing costs driven by fast, simultaneous interconnector ramping. To date, this has not been made available to the Workgroup and there remains significant disagreement as to the salience of the operational drivers asserted by NGESO above. The ESO also noted that there are some instances where the impact to balancing is not negative, however this is less frequent and operationally is still a risk for fast ramping arrangements continue.

Some Workgroup members sympathised with the issues faced in the control room and there were some Workgroup members who raised concerns of the severity of the issue as there have not been frequency events as result of large simultaneous ramping. The ESO advised that whilst it is 'manageable' to reposition units as a result of the change in flow on the interconnector close to real time, it is a risk to security of supply and that this is likely to increase with the additional interconnectors in the future. Some Workgroup members felt that there was no detailed assessment on the impact to the risk to security of supply and that in some cases, slower ramping can lead to increasing risk to security of supply as well

Some Workgroup members further noted that by limiting interconnector ramping, this would also limit benefits seen from rapid market ramping in alleviating regional constraints across normal operation, and these risks should also be factored into a given decision to limit current levels of ramping. It was noted that in some cases, limiting interconnector ramping could reduce the ability for interconnector to support security of supply. Practical considerations surrounding how limits to ramping would be introduced into the control systems of interconnectors, and how trading arrangements would be impacted in the short-medium term were also highlighted and discussed.

Discussion was also held regarding the fact that the current arrangements in place for interconnector ramping were based on agreements made in 1986 when IFA was first commissioned and that the changes to the system over the last 30+ years require a review to ensure system operability.

Recommendations/Solutions

The proposer shared several options for discussion, which aim to resolve the issue operationally (with the aim that these could ultimately be included in the Grid Code). The initial thoughts were as follows:

- Include current bespoke ramping arrangements, as they are, in the Grid Code.
- Apply current BMU ramping rates to the interconnectors as per BC1.A.1.1.
- Ensure NGESO holds sufficient response and reserve to facilitate unrestricted interconnector ramping.
- Dynamic ramping rate - based on an assessment, NGESO will decide if any ramp rate limit needs to be amended.
- Develop additional services with the interconnector and EU Transmission System Operators (TSOs) to mitigate ramping e.g., slow or delay.
- Changes to the GB wholesale market design to be more compatible with cross border capacity markets.
- Change cross border capacity markets.
- Apply a reduced static interconnector ramp rate limit.

The Workgroup was asked to share feedback on these options and detailed discussion took place in meetings relating to the feasibility of them and the impacts that may arise, with the pros and cons being considered for each. The feedback was taken verbally, via polls in meetings and via email. All feedback in this Workgroup has been collated and responded to, it can be found in annex 3. Through the modification process the proposer highlighted which options were and were not in scope. The justification for this was based on the requirements from SOGL and operational drivers for change linked to the ToR for the modification. The Workgroup considered future technology capabilities in this process; however, this was not considered in scope as this work relates to interconnector ramping arrangements only and is considering a solution for the now to medium term, not a long term strategic view.

Some Workgroup members expressed concern regarding the impacts to interconnector imbalance and requested that imbalance costs/data be shared for the ESO to understand and help support development of a solution. Consideration was given to any compensation that may result from imbalance. These costs were requested to be able to consider this as part of the solution.

The ESO proposed a solution it favoured from the discussion held in the meetings and the initial list of solutions. This was a dynamic ramping option. The ESO presented why this was preferred but recognised there were challenges with the option to understand before formally suggesting as the proposed solution.

Through the discussion with the Workgroup and the request for the Workgroup to share thoughts or ideas that they would like to recommend solving the issue, a list was formed of 8 options (9 including the status quo) These were broken down into 3 categories- ramp management, ramping arrangements and market-based options based on conversations in Workgroup meetings. It was recognised by all parties that a market-based solution may not be feasible in this instance. This list shows the solutions for review in the CBA.

Baringa ref	Theme	Suggested solution	Detail
1a	Ramp Management Tools	TSO- TSO agreements	Use the existing ramp rates in Interconnector agreements and add to the Grid Code. Then arrange a tool that allows for SO- SO trades to counteract the ramp to slow down ramping.
1b		TSO- TSO agreements	Use the existing ramp rates in Interconnector agreements and add to the Grid Code. Utilise European balancing platforms to allow for optimisation of products in the market when simultaneous fast ramping requires counteraction
2a	Ramping arrangements	Dynamic ramp rate	Base ramp rate of 50MW allocated to all Interconnectors Additional ramping to be made available based on day ahead forecasting of up to 250MW with a max ramp rate of 100MW. The additional ramping is based on the rate of change of demand forecast
2b		Static ramp rate	Interconnectors have a base rate ramp limit of 50MW the same as generators
2c		Static ramp rate (status quo)	Interconnectors currently connected to the system have a ramping maximum of 100MW- continue with this rate
3a	Market Based Options	Procure increased Frequency response	ESO to hold sufficient Frequency Response to

			facilitate up to 100MW/min interconnector ramping
3b		Base rate set for all IC and a market would be created for IC to participate	Each IC gets a 'banked' 50 MW, and the extra 50 MW is multiplied across the number of ICs, then a market is run for this availability. The IC to choose if they wanted to be in that market.
3c		Create a ramping market	ESO to set up a "ramping market" where, based on the day ahead position of trade and risks estimated across ramping transition a volume dependent escalating ramping price is identified reflecting the costs incurred in operating the GB system, which allows the benefits of offsetting that position to be reflected by those offering flexibility to mitigate it whether interconnectors or other providers

There was not agreement in the Workgroup of a preferred option, despite various in-depth discussion. This led to the agreement that a CBA should be conducted to support the Workgroup in making a decision on a recommendation to solve the issue both from an operational perspective and to meet SOGL compliance.

Cost Benefit Analysis (CBA)

CBA inputs

The Workgroup agreed that a CBA would be required to support the development of the solution. The ESO employed Baringa to complete this independently and included the Workgroup in the process where possible. The purpose of the CBA was to review the list of options collated to review if there was a requirement to change the current ramping arrangements. The Workgroup expressed interest in being part of this process and stated the scope needs to be clear in its scope and assumptions.

The solutions presented to Baringa were discussed in a Workgroup meeting and shared by email to the Workgroup members for comment and review.

Baringa attended several Workgroup meetings. In the first meeting, the purpose was to introduce themselves and to share how it had determined which options it would like to review in the CBA, noting that it was not possible to review all the 8 options in the CBA. Baringa explained the approach they had taken, using the Harvey Balls method, informed by bilateral discussions with the proposer. The Workgroup challenged this approach as there was concern that this was driven by the ESO. There was also concern raised by the Workgroup that any feedback that was shared was not visible as the whole Workgroup were not included in the proposer's bilateral meetings with Baringa. The proposer and

Baringa assured the Workgroup that all feedback received has been shared to Baringa for them to use in their work and Baringa advised the group that the selection process was done independently. This led Baringa to seek the views of the Workgroup to advise what solutions it would have preferred to see modelled with rationale to support this. The objective being to review inclusion of options that all parties were comfortable with.

Baringa attended meetings to update the Workgroup at specific milestones of the CBA and supported discussion to determine what would be included in the CBA. The Workgroup shared two possible solutions to consider in the CBA and Baringa created a set of assumptions based on these options. Some Workgroup members provided feedback, and the overarching comments were responded to. There were some more specific questions which related to implementation, and possible consultation questions to consider that were not directly responded to. There was also an ask back to the Workgroup to provide imbalance data to support the modelling and the CBA work.

The options list was reduced from the original 8 through the shortlisting and options assessment completed by Baringa, supported by bilateral discussions between Baringa and the proposer. Subsequently, this created discussion in the Workgroup and the interconnector parties shared a preference to include specific solutions. Baringa reviewed these suggestions, provided some assumptions to complete the modelling, and reviewed how the solutions were aligned with the scope of work. This then suggested that the final list was as detailed below.

2c-100MW/min (status Quo)
2b- 50MW/min(static)
2a- 50MW/min dynamic option- increased ramping available based on demand
1a-100MW/min with a ramp management service to reduce ramping

Option 3a to include the ESO holding more response and reserve was removed, despite it being an option that could provide market-based solutions, and the dynamic ramping option included as the ESO already had a workstream to review response and reserve, and this was by Baringa's assessment out scope of the work being conducted. The operational issue being addressed is fast simultaneous ramping, which as more IC connect to the network is likely to increase. Increasing the response and reserves (if there are available market parties to do so) does not solve the issue of fast simultaneous ramping. Workgroup members felt that no further suggestion made from ESO how to solve the issue if a market-based solution is to be established. These fast changes in flows across the network also impact system stability and voltage issues and some Workgroup members expressed concerned about this, as this has come up very late during the workgroup discussion and they felt that there is no evidence has been given to support . If there becomes a market that is able to deliver low-cost response to enable faster ramping, then this will be reviewed. The markets roadmap details the work being completed and can be found on the ESO website here.

The Workgroup had a preference to review the TSO-TSO arrangements under option 1a so option 1b was removed from the list.

Option 3b was a combination of option 2a and 2b, both of which were being included in the CBA. This was not included as the Workgroup did not share a preference for this after the Harvey Balls review session.

Option 3c was discussed as part of the Workgroup's solutions, but it was agreed in the meeting that at the present time, there are not enough connected interconnectors to create a market for ramping.

Where decisions for the CBA were concluded, all Workgroup members were invited to review and provide feedback. Where feedback was provided, this supported discussions between the proposer and Baringa regarding the approach and assumptions. Following this dialogue Baringa advised the group which solutions it intended to model and the assumptions it was proposing to use to use. Feedback on the approach was welcomed.

CBA outputs

In the last meeting Baringa attended, they played back the outputs of the CBA. The Workgroup discussed the CBA results at length. The key highlights were:

- Concerns regarding the balancing costs methodology and clarity over the way that volume and cost was calculated. The Baringa representative advised that weighted averages were used to calculate these figures, explaining that the reason for this is that demand is not linear and that by using the data for a year, this gives more confidence. Workgroup members expressed significant concern that Baringa's methodology could not reliably assess the likely impact of each option on GB balancing costs.
- Pointed that there could be actions in the BM that are not IC actions raising some concerns, the ESO representative advised that the IC has a 1hr MTU and the rest of the market has a 30 min MTU and this shows where the IC are likely to be ramping with the Baringa representative adding that this was why the methodology looked at the delta for the instructions on the hour and half hour +/- the 15 mins for ramping periods. However, Workgroup members feel that this explanation by Baringa is still not sufficient as even within the hour change, there are other assets that could be ramping at the same time as Interconnectors so balancing actions around the hour should not be attributed by ramping on Interconnectors alone. The Workgroup discussed about consideration of MPIs- felt that this was not in scope as it is not clear if MPIs are to be treated as ICs.
- Concern that constraint cost and management was not reflected in the analysis which viewed TSO areas as unrestricted in operation.
- Discussions about ramping rate and ramping size, with the Baringa representative advised that there is a combination of both to consider as with more IC the rate increases, therefore it was considered that the best estimate of costs is determined by establishing a relationship with effects the volume and the rate, which will give the suggestion of cost.
- The Baringa representative advised that they have been cautious with the costs so as to not overestimate and that should the numbers be adjusted to IFA then these costs would indeed be greater. Some Workgroup members expressed concerned about the methodology that Baringa used for the CBA.
- Questions raised on system buy and sell price and with the Baringa representative advising that this was based on wholesale prices as using assumed sell prices would be overstating the problem, highlighting again that if there is data that can be shared it would be taken into consideration Workgroup members expressed

concern on this, and felt that Baringa did not understand how the balancing cost has been evaluated, i.e., the replacement cost concept.

- Points raised regarding the use of batteries as response to fast ramping frequency issues and pointed that the market will be different in the future. The ESO representative agreed that batteries are great for this as they can deliver the response in short time, however, there is also the time to re charge to consider and that this is not predictable, advising this could be reviewed in the future where we could be looking at ramping generally, not just for IC.
- Concerns surrounding the use of interim solutions discussed in work group- e.g., staggered ramping, interconnectors holding own reserves. These were beyond the capability of the Baringa model to analyse.
- Concerns about the impacts of imbalance for IC being qualitative and not quantitative and worries about the spill to the next period. The ESO representative advised that data had been requested from the Workgroup with regards to imbalance costs but may not have been provided in it's entirety. Workgroup members noted that interconnector imbalance costs can be fairly calculated from public data. i.e. Elexon, therefore there is no need to require workgroup member to provide this.
- Questions regarding the PLEXOS outputs and how this was impacting the markets, the flows, how this represents consumer welfare and the EU costs. The Baringa representative advised that the flows are in the PLEXOS model, and this is the Pan EU model that is used in industry and well recognized. Explaining that it is also not possible to model a market in real time and that the data used was at the same granularity on both sides- GB and EU. Areas of uncertainty present within this data were discussed but the impact of this not further quantified by Baringa in the CBA report
- The Baringa representative advised the Workgroup that the CBA results are not a recommendation but a high-level overview and a summary.
- Questions about the way the costs for Security or Supply were calculated and the Baringa representative advised that this was qualitative reflected by the control room.
- Concerns regarding the balancing cost for EU/welfare, the Baringa representative advised that this is in the table and that PLEXOS considers the reserves costs for the EU countries – in the table but not explicit.
- Questions about how the EU TSO manage AC ramping and the ESO representative advised that they have bigger network, so it is not as obvious when there is a change to the frequency due to ramping.
- The Baringa representative advised the implementation in the PLEXOS modelling is assuming that the Interconnector capacity connecting GB is the same in all options, recognizing that there may be an impact on Interconnector value from changing the ramp rates and if is sufficiently large, can influence investment, advising that this will be captured qualitatively, not within the PLEXOS modelling but as a separate line item. Workgroup members expressed concern this hadn't been evaluated

- A Workgroup member pointed that when reducing ramping to 50MW/min the biggest concern will be to complete in compliance with the ramping window and if

this is passed into the adjacent period is a serious risk and could increase the imbalance costs, assuming a 15-minute granularity how does Baringa handles this as it can potentially be a significant cost. The Baringa representative advised that they decided to keep demand flat as the markets operate on an hourly basis and only change those inputs granularity for purposes of the IC ramping.

- There has not been clarity over whether the consumer welfare effects of increased imbalance costs for Cap and Floor Interconnectors resulting from lower ramp rates, have been factored into the projected savings to GB consumers.

- The working group still have strong reservations on the outputs of the CBA and have asked for further clarity on some questions. The Workgroup has also requested sight of the underlying data informing Baringa's analysis, to enable validation of the work undertaken, but at the time of writing this has not been provided. Workgroup members also have additional questions regarding the CBA as the potential additional costs to interconnectors are not reflected in the document. The responses to this have been shared to the Workgroup in the feedback file which has been collated and shared to the Workgroup. This can be found in the annex 3.

EU TSO engagement

As part of the initial Workgroup discussion the proposer highlighted that there would be a need to engage with the connected EU TSO in the process. There was agreement from the working group that this was essential, and some Workgroup members wanted the connected TSO to be part of the working group. A standing item was included in the agenda to discuss TSO engagement.

An ESO representative shared an update to the Workgroup of the outputs from a meeting with the EU TSOs on the 31st January 2022. This meeting was to ensure clear communication between the two groups and highlight to the EU TSOs the initial views from the first Workgroup meeting. The ESO further explained to the Workgroup that a TSO Engagement plan was in place and that we would be seeking to engage with the EU TSOs in this process.

The ESO shared outputs from these meetings, noting that due to the changes since BREXIT, GB was not a participant in these meetings, so was sharing the information through a member of that Workgroup. A document with all engagement was shared to the Workgroup at the end of March 2023.

The ESO has since had more detailed discussions with the connected EU TSOs regarding the recommendation from both the ESO and the working group. The ESO has also shared the CBA from Baringa for review. The Workgroup later expressed that more detailed discussion was required

During Workgroup meetings and emails the Workgroup raised concerns that there has not been engagement with the connected TSOs. In response to this, the ESO asked the chair from the Intra Synchronous Area Working Group to attend a working group which was welcomed channel of information which the Workgroup hopes will continue in future meetings if possible. It has also been noted that EU have used HVDC projects such as

INELFE (France- Spain interconnector) for fast AC line emulation, and that similar Grid forming controls are now being specified on new continental European ends of new interconnectors, which would drive near instantaneous power flow swings not captured within ramp rates as defined above.

Consideration of the proposer's solution

There has been significant concern raised by the workgroup regarding the proposer's solution:

- **EU TSO alignment**: There has been a lack of sufficient engagement with partner EU TSO's and therefore changes in parallel by EU TSOs have not been considered. This could create operability mismatches and risks damaging relations where effective co-operation will be essential going forwards.
- **Energy Security Risks:** A proposal to reduce the ramp rate on interconnectors means reducing the speed and flexibility of Interconnectors to respond to system tightness and in most cases to match supply and demand between countries.
- **Insufficient CBA:** Although a significant amount of work has been carried out to present the results of the CBA, there are several areas where the CBA has not quantified and covered deeply enough, particularly the operational risk, implementation costs and impacts to EU markets.
- **Potential negative impact on meeting GB net zero targets:** Despite the best attempts thus far of ESO, the approach risks having a negative impact on the role of interconnection and offshore infrastructure as a key facilitator of the GB and EU energy transition as recognised by UK and EU Governments in recent months.

Members of the Workgroup noted

- The need to limit ramp rates occurs at specific times, relating to a combination of interconnector actions and other energy market factors at those times. The option of applying these more stringent ramp rates only to these specific periods of market stress was discussed as a potential variation of this proposal.
- The lower ramp rate restriction would limit the flexibility that interconnectors currently have to stagger ramps to avoid co-incident ramping.
- High ramp rates are not always a disbenefit to system operation, given that they allow more rapid alleviation of regional constraints in normal operation than would otherwise occur and provide flexibility to respond quickly to market signals on margins and capacity.
- The proposal being retrospective in nature would impact existing control systems interfacing with the market and market contracting and that there were practicalities surrounding its implementation to take into account.

Workgroup expressed concerned that in the single-out of one factor of interconnector coincident ramping only a short-term response to a broader issue was being responded to. The Workgroup noted that as transitions to Net Zero occur, more intermittent generation will need to be "pooled" across TSO areas driving the interconnectors to transfer power to greater volumes and adjust individual positions more rapidly before. This need was not limited to interconnectors, but also a variety of energy storage devices and demand-side actions, and the central challenge was the organisation/ incentivisation of these individual changes such that they do not become herded in nature. By reducing the ramp rate to individual parties, this did not address the point that over time more parties are now

emerging that will respond in similar ways at the same time if action is not taken to address this.

Workgroup members disagreed with the Proposers view of the Baringa analysis output which indicates that the Original proposes to reduce balancing costs by £865m over the study period (2023-2030) to the GB consumer and reduces the impact to security of supply. This balancing cost reduction was not supported by the majority of the Workgroup who felt that there was a lack of detailed data and supporting information, as well as the methodology is not proven

Consideration of other options

Several Workgroup members collectively proposed an alternative to the Workgroup.

WAGCM1

WAGCM1 (see Appendix 5) aims is to codify 100MW/min in the grid code to ensure compliance as per SO GL article 119. The key difference between WAGCM1 and the Original is the codified ram rate value with the Original being 50MW/min and WAGCM1 being 100MW/min.

This relates to reflecting the existing maximum ramp-rate as already detailed in the current operational agreements within the Grid code and the ESO and interconnectors then exploring flexible responses to cumulative ramping within the clarity this provides. Within the alternative Interconnectors have noted they would wish to then explore a range of flexible actions that could be made available to limit balancing costs. These may potentially include:

- Staggering individual interconnector ramping across a given hour of projected coincident ramping impact to the ESO.
- Holding of reserve upon the interconnectors undergoing ramping within the headroom that provides to counteract the need for that to be held elsewhere.
- Operating ramps counter to one-another to limit overall ramping at a given time, a practice already implemented at certain single sites for other reasons (such as voltage support)

Such arrangements range from those available by bilateral agreement, to those requiring new control or updates to existing control whose timeframes for implementation would need to be agreed bilaterally. A date by which such new measures are made available/ and or a reporting of progress towards these could be made a part of this Grid Code modification, and consistent with practicalities of the implementation of the proposal would not be expected to exceed 6 months from implementation.

The alternative also suggests that addressing ramp rates alone does not of itself address the issue of cumulative ramp rates occurring at the same time. It notes there are a variety of contributing factors to how the operational challenges arise which do not completely relate to interconnectors alone, but also other ramping actions, changes in availability of intermittent generation and net transmission system demand. Given the need to ensure timely SOGL compliance, the alternative suggests reviewing the operational challenges

via a further Grid Code modification Workgroup with the view to possibly introduce a market-based tool such as a TSO-TSO ramp management service. A first draft of this proposed further modification is included in Appendix 5. Such a Market could be based on following principles of:

- A given estimated market cost for a given total ramp occurring being attributed at a given time,
- Reflective on that market cost then incrementally charge those BM units contributing to that cost at that time,
- Paying others capable of reducing the net ramping effect at that time in reflection of the benefit to the operator from that action at that time.
- The overall nature of such a market arrangement could be constructed to be cost-neutral in nature to balancing costs, and/or reflect a default assumption of ramp rates allowed without cost incurred. It may provide for short/ medium market/ contract participation to further limit costs incurred.

The exact market proposal is beyond the scope of this Workgroup to formulate and would require the involvement of parties not part of the current Workgroup to deliver an overall solution. The Alternative proposes this Workgroup should aim to start no later than 3 months from the implementation of GC0154 and present initial worked up proposals no later than 18 months from that date.

Other Workgroup considerations

The Workgroup also discussed the option of specific ramping market arrangements to more generally address the issues of coincident ramping. This option was considered by the proposer and the Baringa analysis to represent unjustified complexity and delay in response to the issue. The option of holding balancing reserves on interconnectors whilst ramping was further raised. This option was considered to be precluded by existing EU arrangements- however given that the EU are actively applying this same approach to within EU TSO trades across both HVDC and AC assets it remains unclear why this should be the case going forward.

Across Workgroup meetings there was disagreement in the benefits attributed to the proposal and of the CBA associated with it as discussed above. There was further disagreement within the Workgroup over whether alternative arrangements short and long term should be considered as alternatives to the proposal or options within the proposal. Members of the Workgroup presented WAGCM1 as an alternative to the proposal as discussed above.

Draft legal text

Legal text will be drafted after the Workgroup Consultation has been completed.

What is the impact of this change?

Original

- All existing and new Interconnectors are impacted by this change if the maximum standard ramping rate will be reduced to 50MW/min. This CBA output indicated

that over the study period there was a minimum reduction to IC operations. The change still allows interconnectors to transfer energy to and from the GB system to the same overall extent as before, albeit at a slower rate of change in market position.

- GB Consumers will be positively impacted as there is a potential to reduce balancing costs incurred as a result of fast simultaneous ramping on interconnectors. The study showed a saving of £865m over the study period (2023-2030)

- ESO are positively impacted as this will aid overall operability and system security in the short term. Concern was expressed by some Workgroup members over the longer-term view. The ESO believe that this still allows the use of interconnectors to support the drive to net zero. Some Workgroup members disagree with this view and noted that the current ramp rate or a faster ramp rate would support Interconnectors to deliver/match the intermittency of renewable energy better, hence better support the drive to net zero.

Several workgroup members have disagreed with the above as, in their view, the reduced ramping rate compared to the existing ramping rate could hinder operability and increase the system security risk in some cases. It was felt that this hadn't been covered in the CBA sufficiently. Workgroup members also felt that due to lackof sufficient EU TSO alignment, if this was to be implemented it could cause operability mismatches and damaging effective cooperation between EU TSO and in turn damage GB consumer benefit. Furthermore, it was felt that the impact to meeting GB net zero targets need to be assessed more thoroughly.

WAGCM1

- Interconnectors are not impacted by a change to existing interconnector ramp rate practice as the alternative reflects the 100MW/min rate as currently agreed across the ESO, interconnectors and TSOs. In the short term the flexibility provided by the adoption in the Grid code of this limit shall be used to trigger new approaches to avoid and mitigate instances of combined ramping on a bilateral basis. The progress of adopting these measures and their impact in addressing the issues of combined ramping will be reported to the Grid Code Review Panel

- A further Work group (appendix A refers) will be set up to deliver an enduring market solution to the challenges of combined ramping across all parties. A draft ToR for this Workgroup will be shared in due course.

- GB Consumers will be positively impacted against the status quo as bilateral arrangements are adopted to mitigate these combined ramping conditions. Due to the limitations of the Baringa CBA tool the cost benefit to these actions have yet to be quantified and the Alternative was not explicitly costed in comparison to the Status Quo within the CBA work.

- The GB electricity industry and the ESO are also positively impacted as this proposal will again aid overall operability and system security, still allowing the use of interconnectors to support the drive to net zero in GB and in Europe.

- WAGCM1 by identifying an enduring market route to the central issue of dealing with the combination of ramping events offers the potential for more significant and enduring consumer benefit as these actions are taken under the auspices of the subsequent proposed Workgroup.

Proposer's assessment against Code Objectives

Proposer's assessment against Grid Code Objectives - original proposal	
Relevant Objective	**Identified impact**
(a) To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity	**Positive** Defining and updating ramping rates which reflect the current market participants' capabilities
(b) Facilitating effective competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity);	**Positive** Having a clear set of ramping rates within the code will aid transparency across generation types
(c) Subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole;	**Positive** A more complete consideration of ramping will address its impact on security of supply
(d) To efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency; and	**Positive** Compliance with SOGL Article 119 as retained in GB law
(e) To promote efficiency in the implementation and administration of the Grid Code arrangements	**Positive** By including ramping rates for interconnectors, this will fill a gap in the Grid Code and improve the Code's operability

Standard Workgroup consultation question: Do you believe that GC0154 Original proposal better facilitates the Applicable Objectives?

When will this change take place?

Implementation date
The implementation date is envisaged ideally 10 days after approval by authority, however this will depend upon the solution developed and approval by the authority.

Date decision required by
No specific deadline but requirement imposed at this stage

Implementation approach
The ESO recommendation does not require any system changes, however this will be included as a Workgroup consultation question to ensure no unintended consequences occur as a result of including legal text to state the ramping arrangements for interconnectors in the Grid Code.

Standard Workgroup consultation question: Do you support the implementation approach?

Interactions

☐CUSC	☐BSC	☐STC	☐SQSS
☒European Network Codes	☒ EBR Article 18 T&Cs[7]	☐Other modifications	☐Other

This modification is driven by SOGL, which is a European Network Code. There is the possibility that this modification will need to follow the EBR Article 18 approach due to possible changes to the Balancing Code.

How to respond

Standard Workgroup consultation questions

1. Do you believe that the Original Proposal and/or any potential alternatives better facilitate the Applicable Objectives?
2. Do you support the proposed implementation approach?
3. Do you have any other comments?
4. Do you wish to raise a Workgroup Consultation Alternative request for the Workgroup to consider?
5. Do you agree with the Workgroup's assessment that GC0154 does impact the European Electricity Balancing Regulation (EBR) Article 18 terms and conditions held within the Grid Code?

[7] If your modification amends any of the clauses mapped out in Annex GR.B of the Governance Rules section of the Grid Code, it will change the Terms & Conditions relating to Balancing Service Providers. The modification will need to follow the process set out in Article 18 of the Electricity Balancing Regulation (EBR – EU Regulation 2017/2195). All Grid Code modifications must be consulted on for 1 month in the Code Administrator Consultation phase, unless they are Urgent modifications which have no impact on EBR Article 18 T&Cs. N.B. This will also satisfy the requirements of the NCER process.

6. Do you have any comments on the impact of GC0154 on the EBR Objectives?

Specific Workgroup consultation questions

7. Does the Original proposal or the alternative impact EU TSOs?
8. Has there been sufficient effort taken to seek and obtain European engagement? Y/N/Other- if other what else could have been done?
9. Does the Original proposal / alternative allow for GB to reach its net zero targets?
10. Do you believe the Original proposal or alternative impacts the interconnector business model? (Please consider any commercial and operational impacts)
11. Does the Original proposal / alternative meet the requirements of Ofgem's August 2019 decision on the implementation of the SOGL? (Check if this is incorporated in grid code objectives)
12. Do you believe that the Original/alternative solves the operational challenges faced by the ESO as a result of fast simultaneous interconnector ramping?
13. Do you believe the Original proposal or alternative proposal/s impacts or is impacted by the EU 15 MTU change?
14. Do have any comments on the reliability of the CBA conducted by Baringa? If available, please provide any analysis supporting your response.
15. Are there any considerations for implementation on the Original proposal /alternative proposals? (e.g., IT impacts or considerations)

The Workgroup is seeking the views of Grid Code Users and other interested parties in relation to the issues noted in this document and specifically in response to the questions above.
Please send your response to grid.code@nationalgrideso.com using the response pro-forma which can be found on the GC0154 modification page.
In accordance with Governance Rules if you wish to raise a Workgroup Consultation Alternative Request please fill in the form which you can find at the above link.

If you wish to submit a confidential response, mark the relevant box on your consultation proforma. Confidential responses will be disclosed to the Authority in full but, unless agreed otherwise, will not be shared with the Panel, Workgroup or the industry and may therefore not influence the debate to the same extent as a non-confidential response.

Acronyms, key terms and reference material

Acronym / key term	Meaning
BSC	Balancing and Settlement Code
CMP	CUSC Modification Proposal
CUSC	Connection and Use of System Code
EBR	Electricity Balancing Guideline
STC	System Operator Transmission Owner Code
SQSS	Security and Quality of Supply Standards
T&Cs	Terms and Conditions
TSO	Transmission System Operator
EU	European Union

GB	Great Britain

Reference material

Annexes

Annex	Information
Annex 1	Proposal form
Annex 2	Terms of reference
Annex 3	Feedback document
Annex 4	Baringa CBA outputs for the Workgroup
Annex 5	WAGCM1