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Swedenergy position on the Revision of the Network Code on Requirements for Generators (RfG 2.0)

Swedenergy (Energiföretagen Sverige) represents and gives voice to approximately 500 companies involved in the generation, distribution, sale, and storage of energy in Sweden. Our objective is to contribute to the development of the energy sector for the benefit of society, based on knowledge, a holistic perspective of the energy system, and close cooperation with stakeholders.

Swedenergy ("Energiföretagen") has reviewed the consultation on the Revision of the Network Code on Requirements for Generators and would like to submit the following comments:

Core position

Swedenergy supports the objective of RfG 2.0 to maintain system security and resilience in a power system with an increasing share of converter-connected generation, storage and demand-side resources. In doing so the revised code must preserve the principles of proportionality, legal certainty and predictability for connected parties. Stable and long-term investment conditions for existing generation assets, including hydropower, are essential to ensure continued system reliability and future investments.

RfG's obligations should be based on clearly identified system needs and targeted at technical capabilities that are shown to contribute to system stability and security. Requirements that do not provide a measurable benefit in terms of frequency stability, voltage stability, fault ride-through capability, restoration capability or operational security should be avoided.

The application of new requirements to existing facilities should be limited to cases where a clear and demonstrable system benefit can be established, the required modifications are technically feasible, and the associated costs remain proportionate to the expected benefit. The costs for modifications and demonstrating compliance should also be borne by the party introducing those requirements. This is consistent with the principles of non-retroactivity, regulatory predictability and the protection of legitimate investment expectations.

The criteria for determining when a modification triggers a new RfG compliance assessment must be clarified. Replacement or refurbishment of equipment with functionally equivalent equipment should not, in itself, constitute substantial modernisation. In particular, the replacement or upgrade of AVR systems,

governors, protection systems or plant control systems with functionally equivalent equipment should not automatically trigger a new compliance assessment. Excessively broad interpretations of substantial modernization risk creating unnecessary costs, increasing the number of derogation requests and, in some cases, accelerating the premature retirement of otherwise viable generation assets.

For electric vehicles, EVSE and small-scale inverter-based resources, the proposed framework represents a significant step forward. Clearly defined requirements, harmonized assessment procedures and robust certification schemes are essential to enable efficient large-scale deployment while reducing administrative burden for both manufacturers and system operators.

General Comments

Grid-Forming capability

Comment

Swedenergy acknowledge the increasing importance of grid-forming capabilities in future power systems with a growing share of converter-connected generation, storage, and demand-side resources.

However, RfG should remain focused on the system performance required to maintain secure system operation. The Network Code should define the desired system behavior and performance outcomes rather than prescribe specific control philosophies or implementation methods.

Relevant performance objectives include:

The code should define the required system behaviour, including:

- frequency stability,
- voltage stability,
- fault ride-through capability,
- damping of power oscillations,
- system restoration capability.

Facility owners and network operators should retain the flexibility to select the most appropriate technical solutions to achieve the required performance.

Proposed amendment

RfG requirements should remain performance-based. The Network Code should define the required system behavior and performance outcomes, while implementation methods should remain the responsibility of the facility owner and the relevant system operator.

Separation of Technical Requirements and Compliance Verification

Comment

Compliance verification requirements have expanded significantly over time and increasingly represent a substantial cost driver for for both new projects and modifications of existing facilities.

Technical requirements and compliance verification requirements should therefore be clearly separated. Verification activities should solely be used to demonstrate compliance with explicitly defined requirements and should not create additional obligations beyond those established in the Network Code.

Without a clear separation there is a risk that compliance verification processes evolve into a parallel regulatory process introducing de facto technical requirements that have not been subject to consultation, impact assessment, or regulatory approval.

Verification activities should only be required where they provide a demonstrable increase in confidence regarding system performance or operational security.

Proposed amendment

The Network Code should explicitly state that compliance verification procedures shall not introduce, imply, or enforce functional requirements beyond those expressly defined in the Code.

Verification and Compliance Assessment

Comment

Swedenergy supports robust and effective compliance verification. However, verification methodologies should remain proportionate to the system benefits they provide.

Many modern generation technologies are based on standardized and highly validated platforms that have already undergone extensive verification through:

- type testing,

- factory acceptance testing.
- hardware-in-the-loop testing,
- EMT validation,
- RMS validation,

Requiring extensive repetition of equivalent verification activities at site level may provide limited additional value while significantly increasing project costs and implementation times.

The purpose of compliance verification should be to demonstrate expected system performance behaviour and performance rather than to repeat tests for which equivalent evidence already exists.

Furthermore, the draft introduces highly detailed requirements related to simulation models and model validation. Such requirements should remain proportionate and limited to what is necessary to demonstrate compliance with the applicable technical requirements.

Proposed amendment

Where equivalent confidence can be demonstrated, the following should be accepted as evidence of compliance:

- EU-recognised certification schemes,
- validated RMS models,
- validated EMT models,
- manufacturer type testing,
- hardware-in-the-loop testing,
- targeted site verification tests.

Alternative verification methodologies should be accepted whenever they provide equivalent evidence of system performance.

Simulation, Testing and Model Validation

Comment

RfG 2.0 expands the possibility to require RMS models, EMT models, impedance models, and validation against measured data. At the same time, it remains unclear which requirements are intended to be demonstrated through simulations, which through testing, and which through model validation.

These matters are likely to be further specified through National Compliance Scheme and are therefore h of significant importance to all generation technologies, including synchronous generation assets.

Swedenergy considers it essential that:

- requirements are harmonised across the Europe,
- proportionality is maintained,
- existing national differences are not reinforced,
- clear guidance is established regarding which requirements should be demonstrated through testing, simulation, or model validation.

Proposed amendment

The Code should establish harmonised principles for the use of simulation studies, field testing and model validation to avoid unnecessary national differences in compliance practices.

Relation to ACER's 2023 Recommendations

Comment

The consultation package does not clearly explain how ACER's 2023 recommendations have been reflected in the draft text, which recommendations have been modified, or the rationale for such modifications.

Greater transparency regarding the relationship between the consultation draft and ACER's recommendations would facilitate stakeholder review and improve the transparency of the legislative process.

Proposed amendment

A traceability document should accompany future consultation drafts, explaining how ACER's recommendations have been addressed and providing justification for any deviations.

Fault Ride-Through Requirements Across Synchronous Areas

Comment

The inconsistent implementation of fault ride-through requirements across Europe has been a recurring concern since the introduction of RfG. Particular concerns remain regarding differing fault ride-through requirements within the same synchronous area

The current proposal does not appear to adequately address these differences in requirements.

Furthermore, clarification is needed regarding responsibility and cost allocation where system operators require fault ride-through capabilities beyond the harmonized minimum requirements, including requirements exceeding 150 ms.

Proposed amendment

Fault ride-through requirements should be harmonized to the extent possible within each synchronous area. Where additional national requirements are deemed necessary, the responsible system operator should demonstrate the system need and justify the proportionality of the requirement.

Standby Losses Associated with Grid Support Functions

Comment

Grid support functionalities can increase standby consumption, particularly notable in smaller inverter-based resources.

Available industry experience indicates that enabling grid support functions may result in notable increase in standby losses even when no active or reactive support is being delivered. Especially for single kW inverters, these additional standby losses have an substantial impact on return on investment. The cumulative impact across millions of distributed devices could also become significant.

This aspect should therefore be considered when defining mandatory grid support requirements for small inverter-based resources.

Proposed amendment

The energy impact of mandatory grid support functions should be assessed. Small inverter-based resources should be allowed to enter low-loss standby modes without grid support functionality enabled when no or low active power is exchanged with the grid.

Use of Normative Language

Comment

The draft contains numerous provisions using the term *"should"*.

As *"should"* is generally interpreted as non-binding language, its use can create uncertainty regarding legal obligations and compliance expectations.

Binding requirements should be expressed using *"shall"*. Where no binding obligation is intended, the necessity of retaining non-binding recommendations should be carefully assessed.

Proposed amendment

The document should consistently distinguish between mandatory and non-mandatory provisions. Binding obligations should use the term *"shall"*, while advisory text should be limited to supporting guidance and explanatory material.

Article-specific comments

Clarification of "Secured Fault"

Relevant provisions

Definitions 25 and 27.

Comment

It is unclear whether the definition of a secured fault includes faults cleared by backup protection systems. Such faults are typically associated with substantially longer fault-clearing times than faults cleared by primary protection.

This distinction is important, as the applicable fault ride-through requirements and associated equipment design may be significantly influenced by the assumed clearing time.

Proposed amendment

Clarify whether the term secured fault includes faults cleared by backup protection systems.

Applicability Following Modernization Needs Further Clarification

Relevant provisions

Article 4, in particular Article 4(3); *"for Type C and D, a change of components of a power-generating module except for changes resulting from maintenance."*

Comment

The proposed wording creates significant uncertainty regarding which modifications constitute a substantial modernization and therefore trigger a new RfG assessment.

Generation facilities are routinely subject to refurbishment, replacement of obsolete equipment and lifecycle investments. Such activities are necessary to maintain operational reliability and should not automatically result in a reassessment of the entire facility against updated requirements.

A new RfG assessment should only be triggered where modifications result in a material change to electrical performance at the connection point, including:

- active power capability,
- reactive power capability,
- fault current contribution,
- frequency response capability,
- voltage control capability,
- connection point characteristics.

Replacement of equipment with functionally equivalent equipment should not, in itself, constitute substantial modernisation.

In particular, replacement or upgrading of:

- AVR systems,
- governors,
- protection systems,
- plant control systems,

should not automatically trigger reassessment where the resulting functionality remains materially unchanged.

ACER highlighted the need for a clearer definition of what constitutes a significant modernization in its 2023 work. If we interpret Articles Article 4(1) and Article 4(2) correctly, no further clarification is provided here. Instead, the determination is left to the competent regulatory authority together with the relevant TSO.

The proposed wording risks creating an "all-or-nothing" approach whereby a limited refurbishment project may trigger reassessment of the entire facility against RfG 2.0 requirements. It would mean a fundamental change in asset management, requiring exchange of all parts to be in line with the new legislation even though only one part otherwise needed replacement. This was not part of the original ACER proposal.

This would significantly increase the burden associated with compliance studies, simulations, testing and derogation applications while providing limited aadditional benefit to system security. It may

also discourage investment in the refurbishment and continued operation of existing generation assets.

The principle of proportionality should remain central to modernization assessments.

Furthermore, extending these provisions to Types A and B significantly increases the number of facilities potentially affected creating a substantial risk of administrative burden, increased compliance costs and premature retirement of otherwise viable generation assets.

Proposed amendment

Only modifications resulting in a material change to electrical performance at the connection point should be capable of triggering a renewed RfG assessment.

Reassessment based on increased generating capacity appear reasonable where the increase is genuinely significant, i.e. towards the upper end of the 5-20% range. But it would be preferable to establish a clearer and higher threshold, to thereby promote a more harmonized implementation.

A definition of *maintenance* should be introduced, explicitly stating that replacement of obsolete equipment with functionally equivalent equipment constitutes maintenance.

Article 4(3) should be deleted. If application of new requirements to existing facilities is justified, this can already be addressed through the mechanisms provided under Article 45 following an appropriate cost-benefit assessment.

The interaction between Article 4(3), NRA decisions and proportionate requirements should be further clarified to ensure a harmonized implementation across Member States.

Type Change Following Modernization of Existing Facilities

Relevant provisions

Article 5 an in particular Article 5(3); "*power-generating units of the same underlying technology, where they form an economic unit and where they have a single connection point shall be assessed on their aggregated capacity.*"

Comment

We support the removal of voltage level as a classification criterion. However, aggregation-based classification may produce unintended consequences for existing generation assets.

This concern is particularly relevant for older hydropower stations consisting of several small generating units below that individually fall below Type C thresholds.

Reclassifying such facilities based solely on aggregate installed capacity may significantly increase compliance obligations without corresponding system benefits.

Requirements intended to create a level playing field should not unintentionally disadvantage existing carbon-free generation assets that were designed and constructed under previous regulatory frameworks.

Proposed amendment

For existing facilities, type reclassification following modernization should only occur where the modification materially changes the facility's electrical characteristics and contribution to system performance.

Special consideration should be given to existing multi-unit hydropower facilities to ensure that proportionality is maintained.

Difference Capacity Thresholds Across Europe Including Within Synchronous Areas

Relevant provisions

Article 5 Table 1.

Comment

The continued existence of very different capacity thresholds between Continental Europe and the Nordic synchronous area is difficult to justify from a harmonization perspective.

Such differences result in unequal regulatory treatment of otherwise similar facilities and lead to unnecessary administration and compliance costs for facilities in the Nordic countries.

Proposed amendment

Thresholds should be harmonized within and across synchronous areas wherever technically justified. Any remaining differences should be clearly justified through demonstrated system needs.

Consideration of Significant Grid Users

Relevant provisions

Article 7(3)(e); "*consult with DSOs, where relevant, and take account of potential impacts on their system;*".

Comment

The proposed consultation requirements should explicitly recognize significant grid users whose operations may be affected by implementation decisions.

This is particularly relevant for facilities with specific safety requirements, including nuclear power plants.

Proposed amendment

Include significant grid in parties that should be consulted.

Recovery of Costs

Relevant provisions

Article 9

Comment

The allocation of costs associated with new requirements for existing facilities is a fundamental issue that should be explicitly addressed in the revised RfG.

Existing facilities have made investment decisions based on the regulatory framework applicable at the time of connection. Where additional requirements are subsequently introduced, the resulting implementation and compliance costs arise from a regulatory decision rather than from any action taken by the facility owner.

To preserve legal certainty, investment predictability and legitimate investment expectations, facilities should not be required to bear the costs of complying with retroactively imposed requirements. This is particularly important for long-lived generation assets where investment horizons extend over several decades.

Proposed amendment

Where new regulatory requirements are imposed on existing facilities, the costs associated with implementation and compliance verification should be borne by the party requiring those measures.

The Code should explicitly state that where new requirements are imposed on existing facilities, the costs associated with implementing the required modifications and demonstrating compliance shall be borne by the party introducing or requiring

those measures. This principle should apply to all related activities, including engineering studies, simulations, testing, model validation, equipment modifications and compliance verification.

LFSM Droop Settings

Relevant provisions

Article 15(2) "*the droop shall be between 2% and 12%;*".

Comment

The proposed droop range introduces the possibility of very large active power changes during LFSM operation.

For some distribution networks these power variations may become a network dimensioning factor and may create local voltage management challenges, particularly because transformer tap changers operate on significantly slower timescales.

Proposed amendment

Consider introducing an upper limit for active-power variations resulting from LFSM activation or allowing national compliance schemes to define appropriate limits based on local network characteristics.

Remote Blocking of LFSM-O

Relevant provisions

Article 15(7) "*The power-generating module shall be capable of receiving and reacting to an external signal to enable the relevant system operator to freeze or block active power LFSM-O mode in real-time*".

Comment

The general requirement for power-generating modules to receive and respond to external signals that freeze or block LFSM-O functionality should be reconsidered.

For facilities operated through permanently staffed control centers, direct operational instructions from the relevant system operator may achieve the same objective while avoiding the risks associated with remote blocking functions.

The introduction of remote blocking capabilities may also increase operational complexity and create unnecessary risks associated with unintended activation, communication failures or cyber-security incidents.

Some generation facilities also have vast inherent inertia that needs to be addressed properly. This can be ensured by keeping the staffed control centers in the loop.

Proposed amendment

The requirement for remote LFSM-O blocking capability should not apply where a continuously staffed control center is available and capable of executing operational instructions issued by the relevant system operator. Special considerations should be ensured for facilities where improper handling of inherent inertia may threaten life and equipment.

LFSM Performance Requirements

Relevant provisions

Article 15 and 22.

Comment

Swedenergy supports LFSM functionality as an important tool for maintaining system stability.

However, LFSM requirements should reflect the technical capabilities and operational constraints of individual facilities. Hydropower facilities, in particular, operate under plant-specific hydraulic conditions that may significantly influence achievable response dynamics.

It should therefore remain sufficient that facilities respond as fast as technically feasible. The additional fixed response-time requirements risk excluding otherwise valuable generation assets without providing corresponding system benefits.

The intended use of the LFSM functionality must also be further elaborated to allow assessment of the proposed dynamics. As example, to be able to achieve a response 45% of Pn in 8 seconds may be reasonable and achievable for a Type C hydro if it is followed by a period of time where no further power change is required. But if continued proportional regulation in relation to the frequency deviation is expected, it will not be achievable for many facilities due to waterway characteristics and hydraulic constraints. Some facilities can respond more rapidly than others, while some require longer response times than those specified in the current draft.

Proposed amendment

LFSM requirements should be differentiated between generation technologies and focus on achievable system performance. Plant-

specific technical limitations should be considered, especially for existing facilities.

Prescriptive response-time requirements should where possible be removed in favor of requirements already present to respond as fast as technically feasible.

The way LFSM functionality is used should be harmonized by including an elaboration of characteristics required from activation until normal operation is resumes including how fast the functionality shall be available again for a new activation.

Quick Re-synchronization

Relevant provisions

Article 22(4)(c)

Comment

The intended scope and applicability of the quick re-synchronization requirement are currently unclear.

In particular, it is not evident whether this capability is intended to be a general requirement applicable to all generating facilities, or whether it is only intended to apply where specifically required by system restoration arrangements or specific protection concepts.

Further clarification is also required regarding the meaning of the required response time. Svenska kraftnät has interpreted the provision as referring to the time required for a facility to return to operation following a start signal from the TSO or DSO. If another interpretation is intended, the current wording should be revised to remove ambiguity and ensure consistent implementation across member states.

Proposed amendment

Include description of where the quick re-synchronization requirement is intended to be applied and clear definition of what is meant by re-synchronisation time.

Power Oscillation Damping.

Relevant provisions

Article 31(3)

Comment

It remains unclear whether Article 31(3) introduces new technical obligations beyond those already established under the existing RfG framework.

Further clarification is needed regarding:

- expected performance,
- compliance criteria,
- verification methodology,
- practical feasibility.

Proposed amendment

Provide detailed guidance on performance expectations, compliance criteria and acceptable verification methods.

Existing Facilities Without Modernization

Relevant provisions

Article 45

Comment

Article 45 represents a significant shift in regulatory principle by allowing certain requirements to be applied to existing facilities that are neither new nor undergoing substantial modernisation. This is implemented by national cost-benefit assessments.

While we acknowledge that exceptional system needs may justify the application of specific requirements to existing facilities. But many Swedish synchronic generation facilities were constructed under entirely different technical and regulatory conditions. Any new requirements should therefore only be introduced where the system benefit has been clearly demonstrated and only following a transparent and robust cost-benefit analysis.

Where new regulatory requirements are imposed on existing facilities, the costs associated with implementing the required modifications and demonstrating compliance should be borne by the party introducing those requirements. This reflects the general principle that regulatory obligations should not be applied retroactively in a manner that undermines legal certainty, investment predictability or legitimate expectations.

The technical design of a generation facility is largely determined when the connection agreement is concluded. Major investments in

generators, excitation systems, transformers and control systems are typically procured based on the requirement set valid at that point in time.

Consequently, new requirements should generally apply only to facilities whose connection agreements are concluded after entry into force of the revised code. Retroactive application should only be considered when:

- a clearly demonstrated system need exists,
- a measurable system benefit can be demonstrated,
- the required modification is technically feasible,
- implementation costs are proportionate to the expected benefit,
- a transparent cost-benefit assessment has been completed.

The existence of a technically achievable capability should not, by itself, justify mandatory implementation.

Particular consideration should be given to existing synchronous generation assets, including hydropower facilities, many of which were designed and commissioned under fundamentally different technical and regulatory conditions.

Proposed amendment

Article 45 should explicitly state that the application of new requirements to existing facilities shall be exceptional and supported by a transparent cost-benefit assessment demonstrating that the expected system benefits outweigh the implementation and compliance costs.

New requirements should only be imposed where the system needs have been clearly demonstrated and the resulting measures are proportionate, technically feasible and economically justified.

The allocation of costs associated with implementing required modifications, conducting studies, performing testing and demonstrating compliance should be clearly defined whenever new requirements are applied to existing facilities.

Flicker Requirements for V2G EVs and EVSE

Relevant provisions

Appendix III 6.10 “Individually, the AC V2G EV and the AC V2G EVSE shall limit the harmonic emissions in accordance with the requirements in EN 61000-3-2:2019+A1:2021 and flicker in accordance with the requirements in EN 61000-3-

3:2013+A1:2019+A2:2021+AC:2022 independent of the rated power of the AC V2G EV and AC V2G EVSE."

Comment

The proposed flicker limits based on EN 61000-3-3 are welcome from a harmonization perspective and facilitate a common European market for EVs and EVSE.

However, the specified limits may not provide sufficient margin in weaker low-voltage networks that are commonly encountered in residential areas.

Experience from the evaluation of inverter-based resources connected to Swedish distribution networks based on a criterion that allows for 35% of the EN 61000-3-3 Pst and Plt indicates that significantly lower flicker levels can be achieved without creating barriers to market access or increasing equipment costs.

Addressing power quality issues directly at the source is generally more cost-effective than resolving them later through network reinforcement or corrective measures elsewhere in the system.

Consideration should therefore be given either to:

- introducing more stringent flicker performance requirements, or
- enabling national implementation schemes to apply stricter flicker limits were justified by local grid conditions.

An adjustable flicker-control setting within the EVSE could provide a practical and flexible solution while preserving European harmonization.

Proposed amendment

Consider requiring more stringent flicker performance than EN 61000-3-3 in Appendix III.

Alternatively, allow stricter flicker performance requirements within National Compliance Schemes were justified by local network conditions.

Or, require EVSE to support configurable flicker-control settings that allow adaptation to local grid characteristics.

Need for EVSE Export Power Limitation Functionality

Relevant provisions

Appendix III, section 6 "Certification modules"

Comment

The widespread deployment of V2G-capable EVSE is expected to accelerate, including installations where a V2G-capable vehicle is not yet connected.

To facilitate efficient network planning and allow phased adoption of bidirectional charging, EVSE should include functionality enabling the maximum export power to be configured independently of the charger's technical capability.

Such functionality would allow distribution system operators to allocate export capacity in line with available network capacity while enabling customers to activate higher feed-in levels once the necessary network arrangements are in place.

To minimize administrative burden and customer costs, this setting should be accessible to the customer while remaining subject to the limits established through the network connection agreement.

Compliance can be monitored through existing smart metering infrastructure and contractual arrangements.

Proposed amendment

EVSE intended for bidirectional operation should include configurable export power limits that allow the maximum feed-in power to be adjusted independently of the installed hardware capacity.

Phase Unbalance Requirements for EVSE

Relevant provisions

Appendix III, section 6 “Certification modules”

Comment

Phase unbalance is increasingly becoming a relevant issue as larger numbers of single-phase and unevenly distributed loads and sources are connected to low-voltage networks.

Many European distribution networks currently apply limits on permissible phase unbalance for inverter-connected installations in order to maintain acceptable power quality and voltage conditions.

As EV and EVSE products are generally developed and certified for a European market, it would be preferable to address phase unbalance through harmonized European requirements rather than through a growing number of national deviations.

If harmonization is not considered feasible at this stage, Member States should be explicitly allowed to define phase unbalance requirements through National Compliance Schemes.

Proposed amendment

Introduce harmonized requirements for phase current unbalance for bidirectional EV and EVSE installations.

Alternatively, explicitly permit phase unbalance limits to be specified within National Compliance Schemes where local network conditions justify such requirements.

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