GSR036 Impact Assessment:

Introduction:

GSR036 proposes a modification to the National Electricity Transmission System Security and Quality of Supply Standard (SQSS) to review and increase the upper voltage limits for the 275kV network from +9% back to +10% which it was until 2017, allowing more operational flexibility and supporting the UK's clean energy and Net Zero targets.

This addresses a problem whereby current limits hinder the pace and scale of transmission network development required for 2030 and 2050 climate targets. Increasing the limit to +10% would improve outage planning flexibility, reduce costs, and maintain system resilience through smarter risk management.

The change is expected to have a medium impact on Industry parties including Transmission Owners, NESO, Network Operators, Offshore Transmission Owners, Interconnectors, and Generators by enabling more efficient outage scheduling, reducing outage rejections, and accelerating grid connections without compromising asset integrity.

Aims and objectives of this impact assessment:

This document forms an impact assessment of the changes in the Security and Quality of Supply Standards (SQSS) limit on the 200kV – 300kV network from +9% to +10% post-fault and how this would be beneficial in accepting additional outages and delivering cost savings. For the 275kV network, this represents an increase in the limit from 300kV to 302.5kV post-fault.

Impact on system resilience:

The proposed changes to the 200 kV–300 kV voltage limits in the Security and Quality of Supply Standard (SQSS) for the electricity transmission network are anticipated to have no material impact on overall system resilience for the following reasons.

275kV steady state voltage limit increase:

From discussions in a workshop between all Transmission Owners (TOs) and NESO, it is agreed that reverting to the pre-2017 SQSS limits raising the pre-fault and steady-state upper voltage limit for 275 kV from 1.09pu (300 kV) to 1.1pu (302.5 kV) is appropriate. This position is supported by the Grid Code in Connection Conditions CC.6.1.4 and relevant electrical specifications, as the current limit represents a deviation introduced in 2017 to align with EU standards. The TOs have confirmed that they continue to use the pre-2017 pre-fault and steady-state upper voltage limits on their 275 kV networks. Therefore, relevant Electrical Specifications for connections to each Transmission Owner's network still referring to the 1.1pu (302.5kV) values that equipment should be capable of withstanding. It was confirmed by the TOs that the voltage limit change would have negligible effect on the generation side, as this implementation is a reversion to pre-2017 ambience.

Post-fault voltage limits at 275kV:

There is currently no supporting evidence to justify increasing the pre fault and steady state upper voltage limit above 1.1pu (302.5 kV). Doing so could potentially reduce system resilience or risk damaging transmission assets. Any such change would require detailed asset level risk assessments and a Grid Code review to ensure that equipment remains within safe operating limits.

Nominal Voltage	PU Value (1pu relates to the Nominal Voltage)	Minimum (percentage of Nominal Voltage)	Maximum (percentage of Nominal Voltage)
200kV up to and including 300kV	0.90pu- 1.10pu	-10%	+10%

Case studies:

The case studies below demonstrate how the proposed voltage increase could impact the operation of the electricity transmission system if implemented.

Importantly, no real events have been identified that exceed the 9% limit on the 275kV network. All examples presented here are based on calculated voltage limits derived using the Power Network Analyser (PNA) tool. These scenarios involve network faults that would create an 'insecure' system, one that falls outside the SQSS limits.

One possible explanation for the absence of real events exceeding the 9% limit on the 275kV network is the stricter 5% limit applied to the 400kV network. As a result, voltage breaches are typically detected on the 400kV network first, prompting operational interventions before the 275kV network voltage limits are reached.

CASE STUDY 1:

Scenario/Constraint **Overview**

In this scenario an outage combination on a circuit in West London, combined with an outage on a circuit connecting the area to South Wales, led to high voltages at two West London substations. The simulated volts reached 300-301kV, compared to the existing limit of 300kV (+9%). An interconnector was out of service in the simulation, meaning its STATCOM was not available for voltage support. In addition, a voltage control circuit (VCC) in the area was required to remain in service. VCCs can normally be switched out as a means of managing voltage levels.

The simulated network represented a lightly loaded system, typical of overnight conditions. A range of operational actions was tested in the study, including tap staggering, adding additional generation, and network reconfiguration. The only option that successfully reduced the postfault voltage to within the existing limits would have introduced additional demand risk (single circuit risk). As such, this action would not be considered viable in real time operational timescales.

Worst Trip and **Overload**

The most severe contingency identified in this study was the loss of a mesh corner at a West London substation. Under this event, postfault voltage levels were observed in the range of 300–301 kV, corresponding to approximately +9% to +10% above the nominal 275 kV voltage.

Observations **and Conclusions**

Under the increased postfault voltage limits proposed in the Electricity Commissioners' report, voltages would be considered acceptable up to 302.5 kV (+10% of nominal). Based on this, the postfault voltages recorded in the simulation fall within the proposed secure operating range. Consequently, with a +10% upper limit applied, this outage scenario would not present a security or compliance issue. The outage combination assessed in this study could therefore proceed under the revised limits without requiring additional operational intervention.

CASE STUDY 2:

Scenario/Constraint Overview

This case study examines a simulation of elevated postfault voltages across the West Midlands. A change in wind generation output resulted in reduced north–south power flows and an increase in system voltage gain within the region. Under these revised conditions, the postfault simulation identified that the system would become insecure, with the worst-case voltage reaching 304 kV at a key substation.

The affected substation group has limited access to reactive compensation or controllable generation, restricting the number of viable mitigating actions. No operational action tested—such as reactive switching, network reconfiguration, or generation adjustment—was effective in lowering the voltage to within secure limits.

System loading was low and representative of typical overnight demand conditions.

Worst Trip and Overload

The most severe contingency examined in this scenario was a double circuit fault affecting the group. The resulting postfault voltage was 304 kV, exceeding both current and proposed operational limits.

Observations and Conclusions

Even with the proposed increase in the postfault upper voltage limit to +10% (302.5 kV), the simulated voltage of 304 kV would remain outside the secure range.

However, the exceedance observed in this scenario was driven by changed system conditions rather than an inherent design weakness. An increased +10% limit would provide additional operational flexibility and would allow similar low magnitude events to remain within limits, thereby reducing instances of unnecessary operational constraints.

CASE STUDY 3:

Scenario/Constraint **Overview**

This case study analyses a simulation of high postfault voltages in the Northwest following a traffic accident that caused the loss of a single circuit and associated synchronous compensation. To maintain postfault security, a voltage control circuit was returned to service. Regional generation was unavailable due to planned outages.

A subsequent simulated fault (a further double circuit event) showed the network to be insecure, with voltage limits exceeded at two substations: 302 kV at the most affected site and 301 kV at the secondary location. System loading was low, consistent with overnight demand.

Worst Trip and **Overload**

This scenario represents a combination of:

1. a planned outage,
2. a fault induced outage experienced on the system, and
3. an additional double circuit contingency simulated on the network.

This sequence represents a low probability Mult contingency scenario. Postfault voltages ranged from +9% to +10% at both impacted substations.

Observations and **Conclusions**

Under the proposed postfault upper voltage limit of +10%, all voltages in this scenario would remain within secure limits. Consequently, the requirement to issue a Voltage Event Report (VER) would be eliminated under the revised standard. This adjustment highlights how the increased limit would enhance the security of supply and alleviate unnecessary operational burdens during rare Mult contingency events. By removing the need for a VER with the new limit, reinstating the Voltage Control Centre (VCC) for demand security, and adjusting the voltage limit, the system's overall security would be significantly improved.

This proactive approach ensures security of supply and reliability of power network, capable of effectively responding to both planned and unplanned operational scenarios.

CASE STUDY 4:

Scenario/Constraint Overview

This scenario evaluates simulated high postfault voltages arising overnight in the Northeast of England. The assessment assumes that key generators were unavailable and essential reactive compensation equipment was out of service. Under these conditions, the simulation indicated that the system would be insecure following a single circuit contingency, with the worst case postfault voltage reaching approximately 301 kV at the most affected substation.

Worst Trip and Overload

This scenario considers:

1. unavailability of strategically significant generation,
2. unavailability of reactive equipment, and
3. a subsequent single circuit fault simulation.

This combination represents a medium probability scenario. The highest observed voltage was between +9% and +10% of the nominal level.

Observations and Conclusions:

With the proposed +10% postfault voltage limit, the system would remain within secure operating thresholds. The increased limit would enable the requested outage of reactive equipment (such as reactors or capacitors) without compromising system stability or requiring additional reactive support services.

By allowing such outages to be scheduled while maintaining adequate voltage margins, the system could avoid unnecessary operational costs and preserve stability during unforeseen events. This supports the case for security of the transmission system and enhanced operational flexibility under the revised limits.

Conclusion:

The Transmission Owners' publication (2017) demonstrated that transmission assets were designed to withstand upper voltage levels of 1.1pu (302.5 kV), in line with the Grid Code (CC.6.1.4) and the relevant electrical specifications for equipment connected to each TO's network.

These standards continue to reference 1.1pu as the required equipment capability.

Across the case studies presented, it is evident that increasing the postfault voltage limit to +10% can deliver systemwide benefits, including:

- enabling a broader range of outages to proceed without compromising SQSS security criteria.
- reducing the likelihood of unnecessary operational interventions or Voltage Event Reports (VERs).
- avoiding the need for additional generation dispatch or reactive support, thereby reducing operational costs; and
- improving the security of supply by retaining a greater voltage margin during abnormal system conditions.

Overall, adopting the increased voltage limit enhances the efficiency of system operations, ensures asset security, and improves the ability to manage the network under both planned and unplanned conditions. By maintaining a greater voltage margin, these changes provide the flexibility needed to take timely mitigating actions, thereby enhancing demand security. This proactive approach not only supports the stability and reliability of the power system but also ensures that the network can effectively respond to varying operational scenarios and potential disruptions. Research through the outage management database found five examples in 2024/2025 that could have been affected by the proposed changes in the voltage. Ultimately, this contributes to a secure energy infrastructure.